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AMERICAN
GAS JOURNAL
Established 185 Pioneer of the Gas Industry*
Manufactured and Natural Gas·

More Trench . . on More Jobs . . at Less Cost

FOR Gas Trenching, the Cleveland Baby Digger commands preference because of the proved correctness of its compact patented design . . . because with its Special Trailer it is available for use anywhere, at any time . . . because it is a fast, rugged, economical machine to operate . . . and because it is *quality built.*

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"Pioneers of the Small Trencher"
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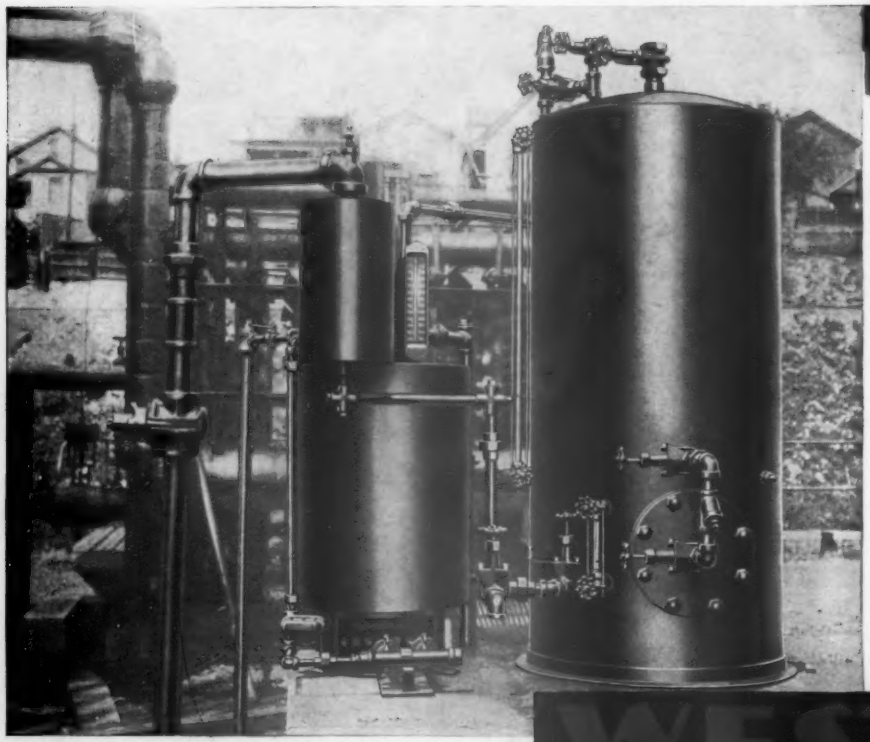
The CLEVELAND BABY DIGGER



A Gas Heated Oil Fogger Installation -- one of the 102 now in service

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An Ounce of Prevention –

Service stoppages, pilot outages and a high "unaccounted for" resulting from the drying out of distribution systems caused by a change-over from manufactured to natural gas, can be prevented by the installation of "Western Gas" Oil Foggers.

Natural gas being a powerful drying agent soon absorbs all moisture in the mains as well as the drip oil from joint packings, meter leathers, etc., resulting in dust troubles and joint leakages. Avert these troubles by the admixture of oil to the gas now being delivered by the system, so that it will be thoroughly lubricated at the time natural gas is admitted. The cost is only a few hundredths of a cent per M cubic feet gas treated.

A copy of our Bulletin No. 310 will be sent to you upon request.

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SUBSIDIARY OF THE BARTLETT HAYWARD CO.

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- ABC Generator Grates
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- Oil Foggers
- Oxide Boxes (Purifiers)
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- Welded Steel Pipe, etc.

AMERICAN
GAS JOURNAL
Established 1858 *Pioneer of the Gas Industry*

Manufactured and Natural Gas

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R. S. MCBRIDE, *Consulting Editor*, Washington, D. C.

Vol. 134, No. 4 April, 1931 Whole Number 3688

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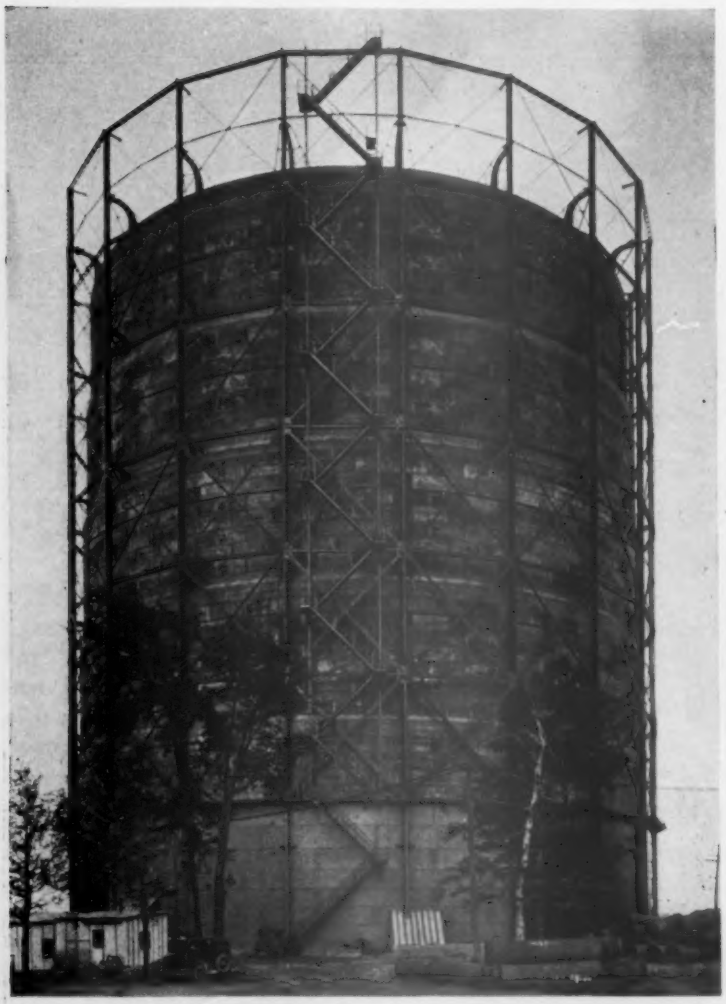
53 Park Place, New York

The Builders of *STACEY* Holders for Over 80 Years

Ready for Gas in *Less* Than *Four Months!*



Quick action is what the Consumers Power Co., of Flint, Mich., wanted when they gave us the order for this five million cubic foot gas holder shown here. They got it.

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When you install SEMET-SOLVAY VALVES AND BLAST GATES throughout your plant, you equip your low pressure gas and air lines with standardized, dependable regulating equipment.

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ENGINEERING CORPORATION
Division Allied Chemical and Dye Corp.
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Send for our new Bulletin No. 44 on Semet-Solvay Piping and Valves.

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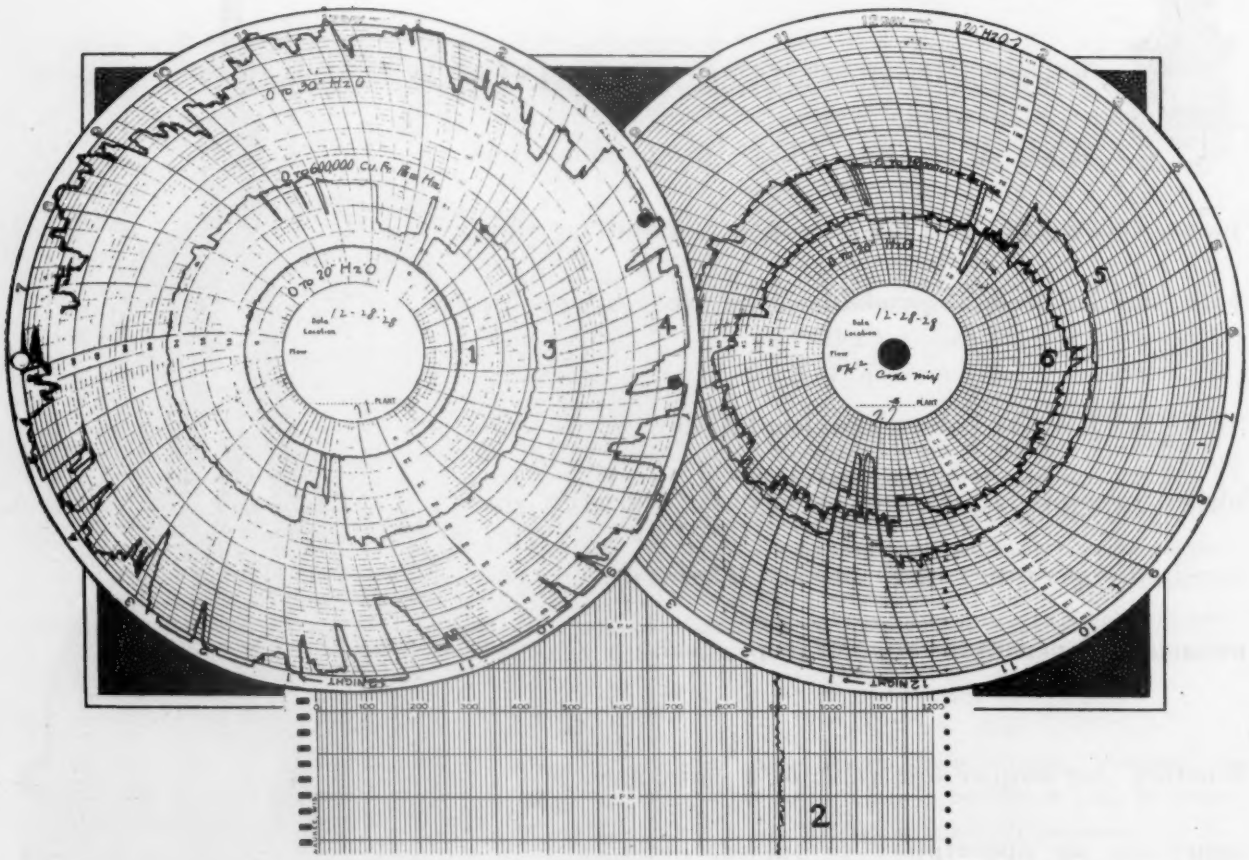

Smoot Gas Mixers are Accurate and Quick Acting

The charts above are taken from a large Smoot Gas Mixer

This Gas Mixer gives these very desirable features as illustrated by the charts.

Chart 1—Constant Mixed Gas Pressure
Chart 2—Good B.T.U. Regulation

These secured with

Variable Lean Gas Flow and Pressure Charts 3 and 4
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Consider, for a moment, the

HUGE BULL RIVETERS

now at work on a new 10,000,000 cubic foot

GAS HOLDER

If you were to watch one of these giant machines pushing their hundred tons against one heavy rivet after another, we believe that, somehow, a thought of Cruse-Kemper's carefulness in this important erecting operation would cross your mind.

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More practically, these great riveters offer evidence of Cruse-Kemper's full equipment, of the capacity for doing classes of steel plate construction from the smallest to the largest.

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The rapidly developing house heating load is frequently taxing the capacity of existing manufactured gas plants and natural gas lines, with resulting peak load problems. Philfuels G-4 Butane offers a most reliable and adequate source of Peak Load Gas, together with economies exclusive to Butane—PLUS—a thoroughly competent and readily available engineering service exclusive with Philfuels Company in the liquefied gas field.

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(Subsidiary of Phillips Petroleum Company)

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DETROIT . . . . . MICHIGAN

the ultimate *protection against corrosion*

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Photographs courtesy of Hill, Hubell & Company, Division of General Paint Corporation

Pipe *mechanically wrapped at the mill*

with J-M Asbestos Pipe Line Felts

EVERY pipe line owner knows that the one way to prevent corrosion is to keep pipe dry. Johns-Manville Asbestos Pipe Line Felts, properly applied to clean pipe, protect it from moisture and insure long life and uninterrupted service.

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Johns-Manville Pipe Line Felts are made from Asbestos Fibre, a mineral product that can never rot or decay. They are saturated with either tar or asphalt base bitumen to meet customers' specifications. Tough and pliable and amply strong to resist soil stress, J-M Asbestos Pipe Line Felts are not susceptible to soil bacteria, acids or alkalis. They have sufficient electrical resistance to prevent electrolysis. Twenty-five years' use has demonstrated their efficiency.

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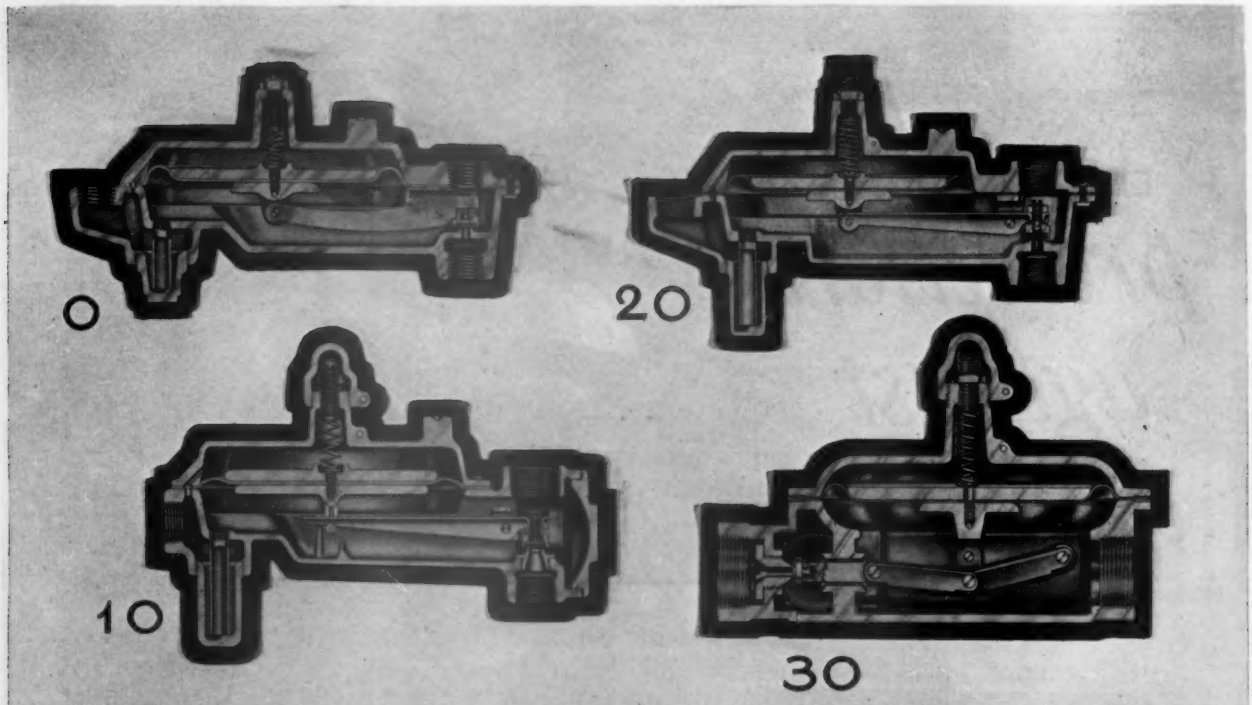
Send for our booklet, "Safeguarding Your Pipe Line Investment," which tells the story of this permanent pipe protection. Address Johns-Manville, 292 Madison Ave., New York City.

(ABOVE)—*Applying Johns-Manville Pipe Line Felts by wrapping mechanically in the mill.* (AT LEFT)—*For pipe that has left the mill unwrapped J-M Asbestos Pipe Line Felts can be wrapped by hand or by machine, in the yard or in the field.*

Johns-Manville *pipe line protection*

This trade-mark is the stamp of quality on insulations, packings, refractory cements, asbestos and asphalt shingles, Transite fireproof roofing and siding, built-up roofing, industrial flooring, waterproofing and numerous other products which serve the Oil and Gas industry.



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The new Model 30 is distinctively Reynolds—it is a development from the original Little Giant Regulator. Model 30 is made in seven styles for any service regulation requirement. Write for our new Catalog K, Section 4.

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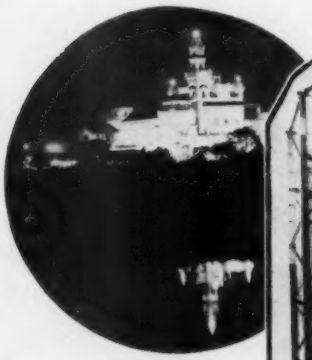
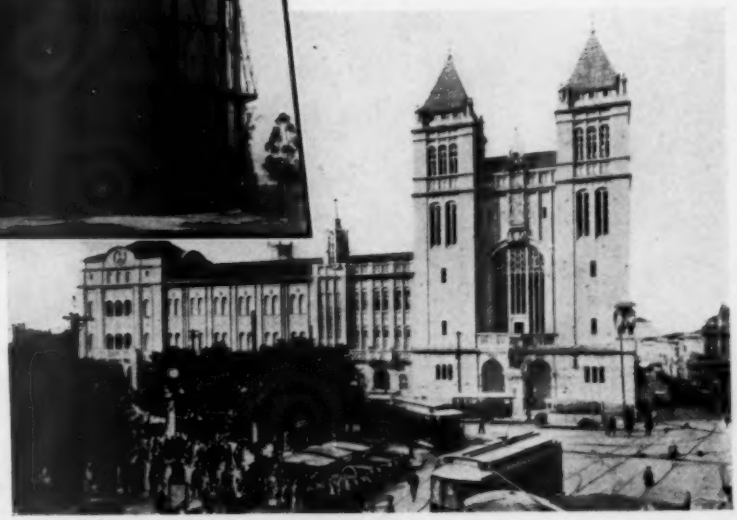


Palacio das Industrias

Stacey Bros. Holder

in modern São Paulo



A nova basilica

Beautiful, modern São Paulo, Brazil! You will find the half-million residents intensely interested in completing their *Plano de Avenidas* to make the city the most gorgeous, well-appointed and up-to-date metropolis in existence.

Gas is playing an important part in São Paulo's development, and the careful planning for the future is reflected in the choice of the 2,000,000 cubic foot Stacey Bros. Gas Holder.

So often a city outgrows or obsoletes its industrial equipment. São Paulo has planned well for the future by choosing a Stacey Bros. Holder.

Let us tell you more about our holders, "Bullets," purifiers, pressure tanks, scrubbers, condensers, tanks, stacks and penstocks that are unexcelled in materials and workmanship, highly resistant to corrosion and wear, and require a minimum of maintenance.

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(Division of The Stacey Engineering Company)

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For Patching Hot Retorts, Refractory Linings, etc. Shipped in 110 lb. bags.

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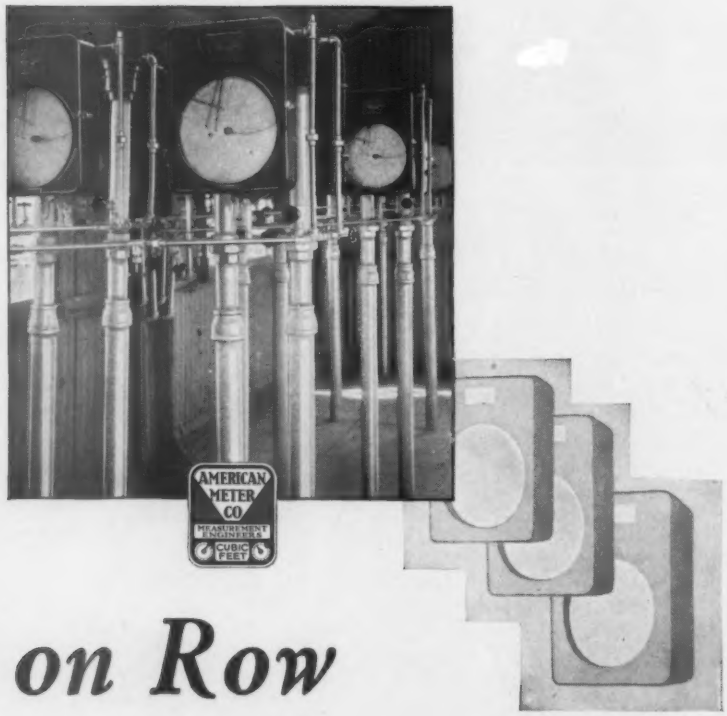

Interior view showing one of two Westcott Orifice Meter settings in a Louisiana station of the Southern Natural Gas Company.

Row on Row of Reliable Records

Less than twenty years ago no Gas Company's financial executive or customer would have accepted the records of an Orifice Meter. Then it was merely an interesting laboratory apparatus.

Today millions of cubic feet of gas are bought and paid for on the authority of tens of thousands of Westcott Orifice Meters. The absolute reliability of the Westcott Orifice Meter is universally recognized and this instrument is writing a new chapter in the annals of the Gas Industry.

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Oxy-acetylene welding under Procedure control is a proven method of insuring satisfactory and economical results in joining oil and gas pipe lines.

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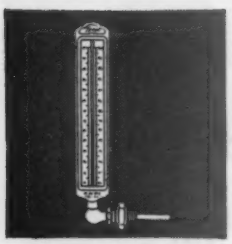
LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES • UNION CARBIDE

Tycos Instruments

INDICATE
RECORD
CONTROL

Temperature and Pressure Throughout the Gas Plant



ALL along the line Tycos Instruments enable you to maintain correct temperatures and pressures in your gas plant at all times.

On the coal bench . . . the carburetted water gas machine . . . in the purification equipment . . . the distribution system . . . for highest efficiency, use Tycos Instruments.

There are 25 places in making coal gas —13 places in carburetted water gas— 9 places in producer gas—2 in oil gas —throughout the plant, Tycos Temperature and Pressure Instruments increase operating efficiency.

Write for Catalog Part 600, especially for the Gas Industry.

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Regulators, Temperature
Regulators, Pressure
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The deLavaud Handbook gives complete details and specifications. For free copy address: United States Pipe and Foundry Co., Burlington, N. J.

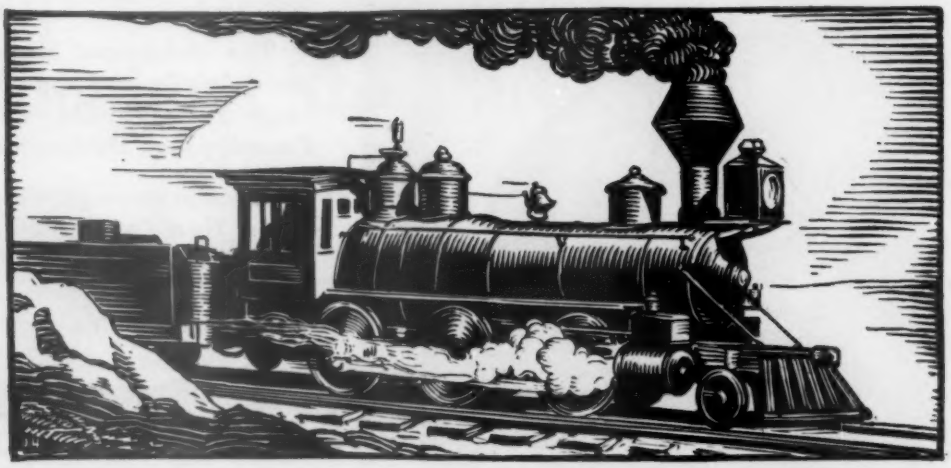
Sales offices located in the following cities: New York, Philadelphia, Pittsburgh, Cleveland, Buffalo, Chicago, Dallas, Birmingham, Kansas City, Minneapolis, Seattle, San Francisco, Los Angeles.

CAST Q IRON

Our pipe bears the "Q-check" trademark of The Cast Iron Pipe Research Association

Illustration shows the deLavaud machine in action.

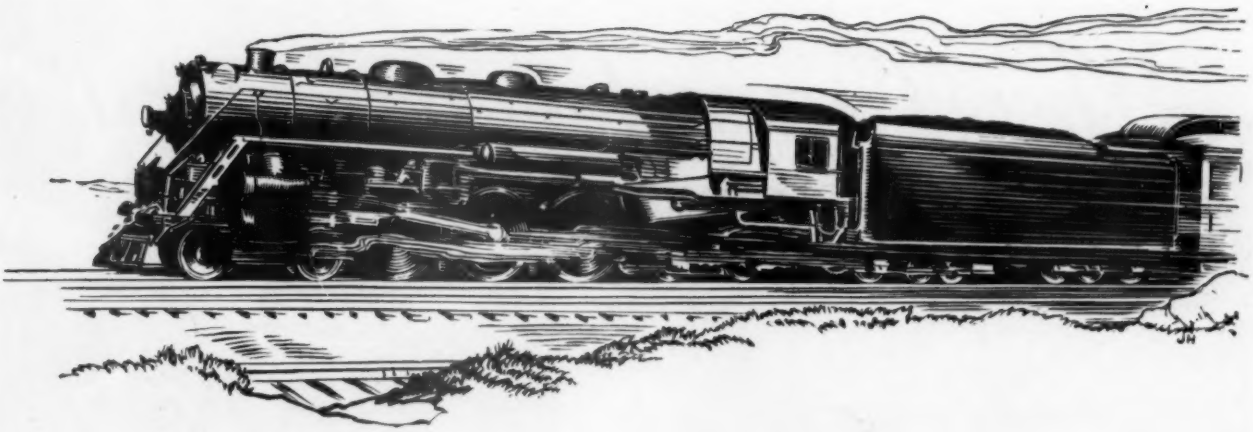
In 1876 Cincinnati laid *Cast Iron Gas Mains which are still in use*



In 1876, when the latest type of railroad locomotive came to a wheezing halt at the Cincinnati station, there were doubtless many among the cinder-laden passengers who exclaimed over the marvels of railroad transportation.

But today, when stream-lined giants of mighty power whisk 14-car trains at space-annihilating speed, we complain if the road bed jiggles the coffee in our cup.

Just as the demand for greater efficiency in railroad transportation has increased, so has the demand for better gas service increased. And the gas industry has kept step with the modern demand. Therefore, it becomes a noteworthy tribute to cast iron mains, when in many leading cities, we find original cast iron pipes, some laid nearly a century ago, still meeting the exacting demands of 1931.



...*naturally,* Cincinnati specifies *Cast Iron Gas Mains* TODAY

Unquestionably, the cast iron mains laid 50 or more years ago were of remarkable quality. But, during the generations of their service, many advances have taken place in foundry practice. And, it is certain that today's cast iron pipe is capable of establishing even greater records of service.

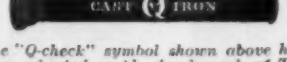
Today's cast iron pipe is produced by efficient modern machinery. The quality of the metal itself is guarded by scientific laboratory control. Pressure tests and hammer tests further assure the strength and uniformity of every length. Cast iron gas mains being made today are entirely in keeping with today's idea of gas line efficiency and higher pressures.

For further information regarding the advantages of specifying modern cast iron pipe for modern gas mains as well as for water, and sewer lines, road culverts and industrial needs, address The Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer, 309 Peoples Gas Building, Chicago, Ill.

[*Efficient mechanical joints for cast iron gas mains are now in use and obtainable for high-pressure gas distribution.*]

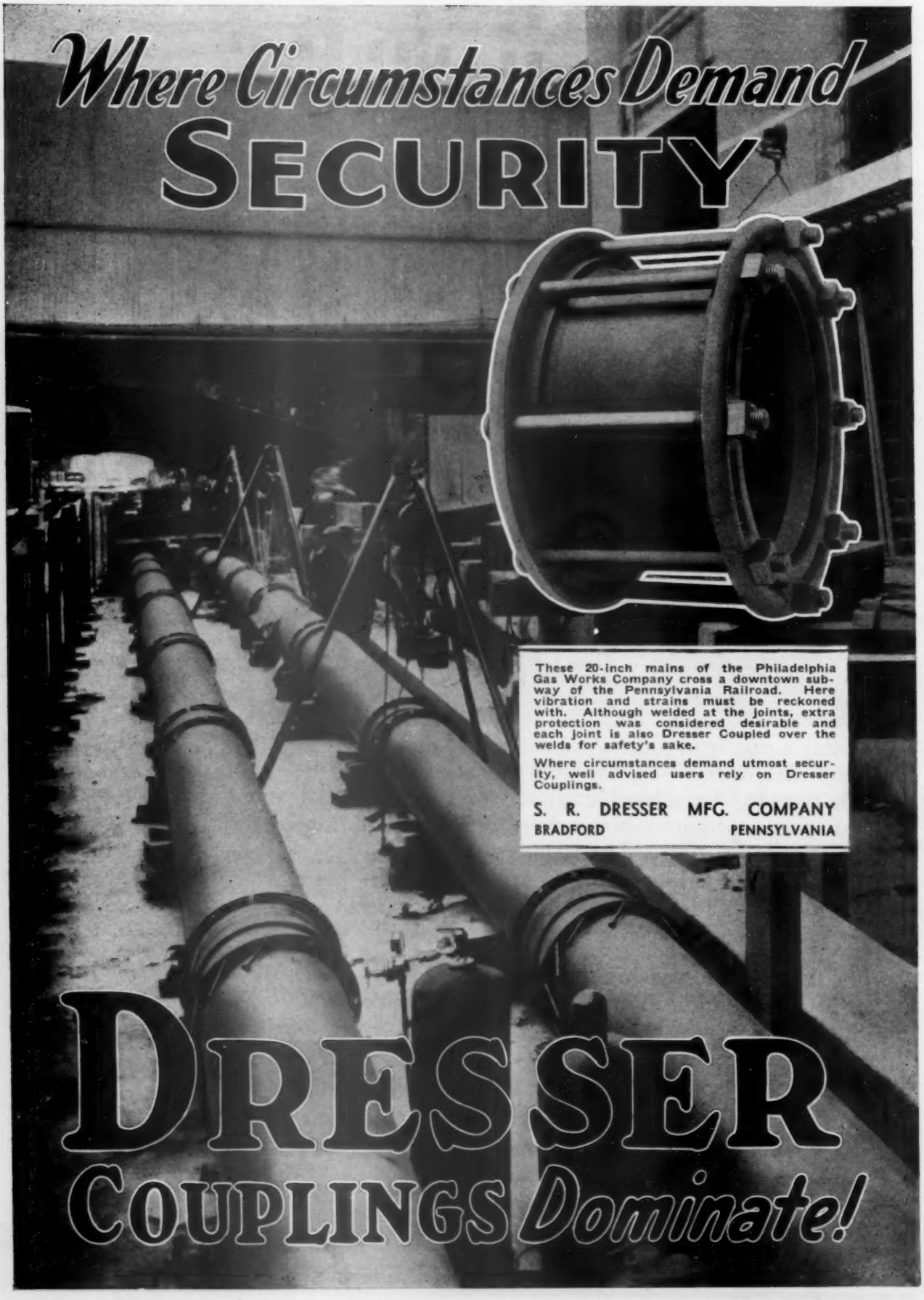
Cast iron pipe bearing the "Q-check" trade-mark is obtainable from the following leading pipe founders: Alabama Pipe Company, Anniston, Ala.; American Cast Iron Pipe Company, Birmingham, Ala.; James B. Clow & Sons, 219 N. Talman Avenue, Chicago, Ill.; Donaldson Iron Company, Emaus, Pa.; Glamorgan Pipe and Foundry Company, Lynchburg, Va.; Lynchburg Foundry Company, Lynchburg, Va.; National Cast Iron Pipe Company, Birmingham, Ala.; United States Pipe and Foundry Company, Burlington, N. J.; Warren Foundry and Pipe Company, 11 Broadway, New York.

Reg. Trade Mark



The "Q-check" symbol shown above has been adopted as the trademark of The Cast Iron Pipe Research Association.

CAST IRON PIPE


Where Circumstances Demand
SECURITY
These 20-inch mains of the Philadelphia Gas Works Company cross a downtown subway of the Pennsylvania Railroad. Here vibration and strains must be reckoned with. Although welded at the joints, extra protection was considered desirable and each joint is also Dresser Coupled over the welds for safety's sake.
Where circumstances demand utmost security, well advised users rely on Dresser Couplings.
S. R. DRESSER MFG. COMPANY
BRADFORD PENNSYLVANIA
DRESSER
COUPLINGS Dominate!

This Booklet —*tells all about*

KROMEPATCH

THE MULTI-BOND CHROME CEMENT

Shipped in Steel Drums 200 lbs. Net Wt., 212 lbs. Gross Wt.

Kromepatch is a "Properly Prepared" Dry Chrome Ore Cement

Just to show you how interesting this little BOOKLET "really is,"—here are a few of the very brief chapter headings:

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Lay Furnace Brick in *Kromepatch* and "Prolong the Service Life of Your Refractory Linings."

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Mr. ..... Title .....

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Address .....

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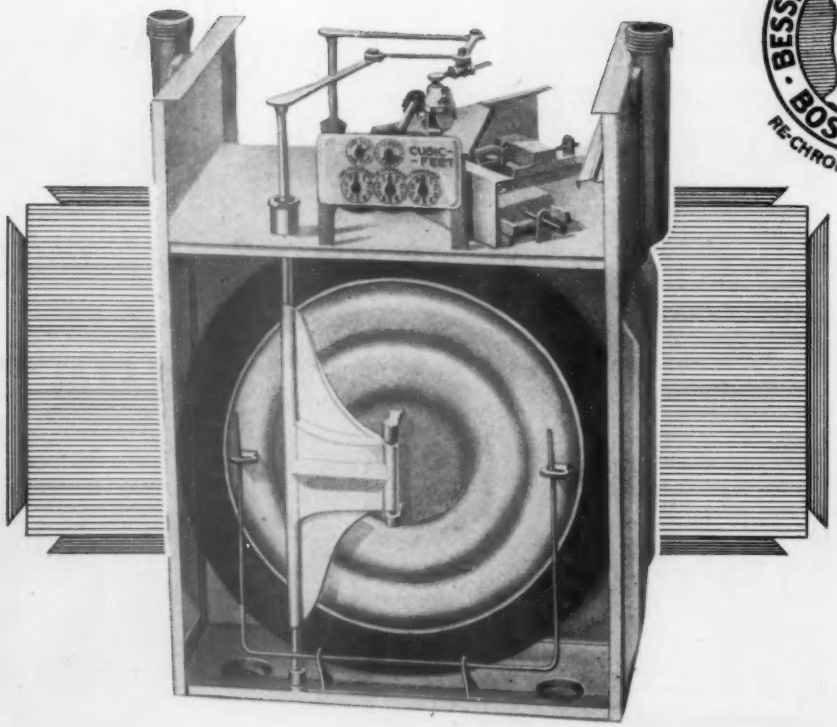

DETERIORATION and DECAY

CANNOT TAKE PLACE WITH COLONIAL METER RE-CHROME LEATHER

A TEST equivalent to five hundred years of actual service has been made, which proved conclusively Re-chrome Leather is superior in every way for Meter Diaphragms. It proved that Re-chrome solves and controls the most stubborn operating conditions.

Colonial Re-chrome has many proven advantages over bark tanned leather. Re-chrome tannage produces a more flexible-thinner-moisture resisting leather which cannot be washed out and having large strong fibers possessing greater strength.

Today when gas engineers consider meter leather they think in terms of Colonial Re-Chrome leather, because it lasts longer.

COLONIAL METER LEATHER

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use the coals that America's greatest producers have specified for years on a basis of proven worth and performance. Criterion...Admiralty...Stonega...Roda ...and Crozer...are of *particular interest* to the Gas and Cooking industry because they best meet those industries' *particular needs!*

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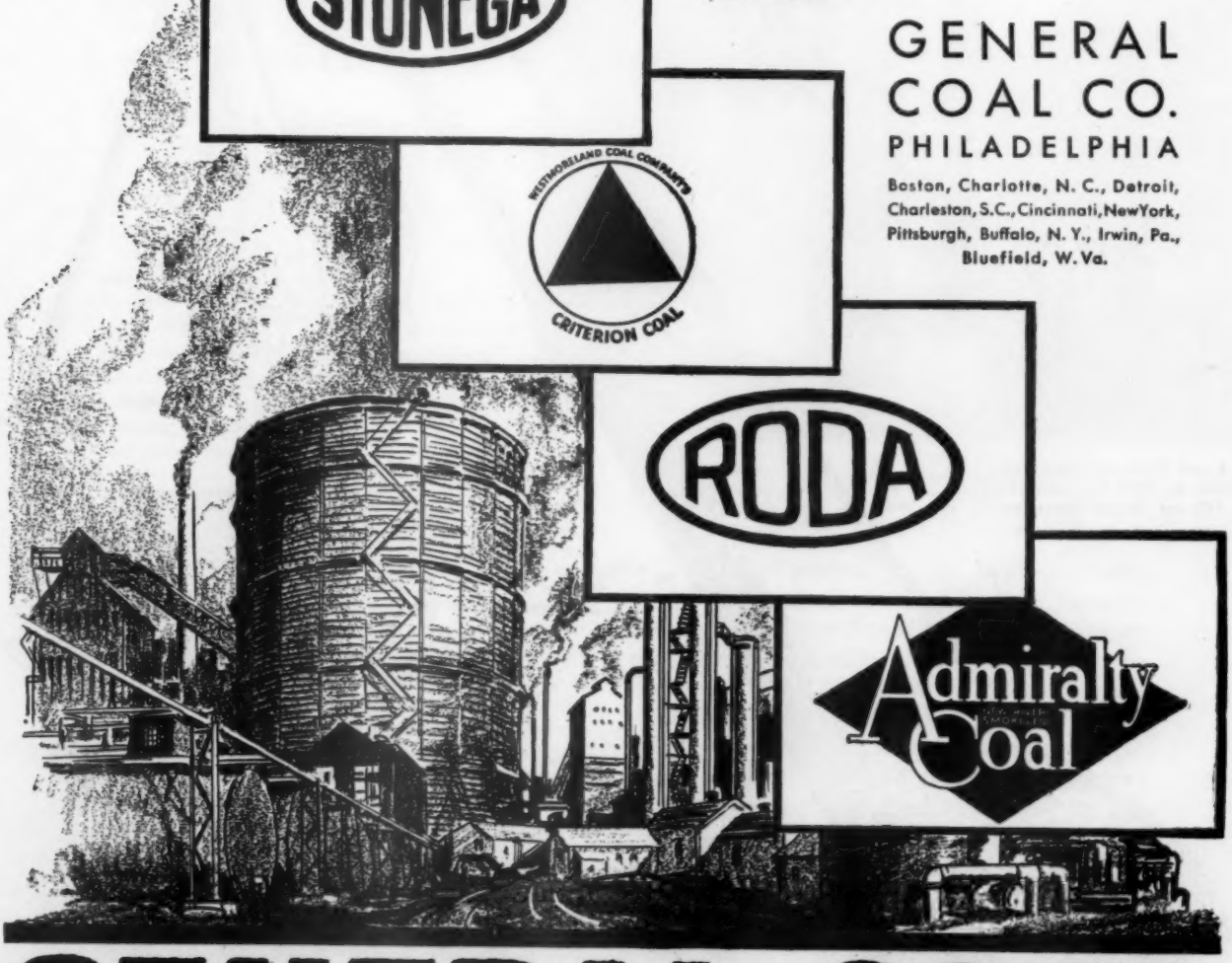

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Lead Melting Furnaces 200 to 800 lb. capacity Oil or Wood Burners on Legs or Wheels

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"Check and ✓✓ DOUBLE CHECK"

Mr. Special Correspondent!

(your article exactly describes our experiences here at Acipco)

4200-foot installation 8-inch Mono-Cast Doublex Simplex Pipe at Pittsburgh, Pa. Over 30 per cent of the largest gas companies are now using cast iron pipe for high-pressure mains.

"IN the early days, the impetuous desire to build cheap and show a profit on the investment before the wells went dry, overshadowed any thought of building beyond the immediate future . . . (Today, however) the natural gas companies are organized on the highest plane and building for permanence, and with consideration to making operating profits rather than on the promotion and sale of properties . . . Cast iron pipe is now being used by many manufactured gas properties where the pressures are as high as 80 pounds and by natural gas properties where pressures are 200 pounds . . . Not only has a satisfactory joint been developed, but cast iron pipe made by the centrifugal method has been developed that produces a material very much superior to pit cast pipe. The centrifugal process pipe is free from all blow holes, slag inclusions and other defects that castings from other processes are subject to."—*(American Gas Journal, October, 1930, issue)*

✓ ✓ ✓

These are familiar words to us here at Acipco. The policy of gas operating and holding companies has been definitely reflected in the increased demand for Doublex Simplex Pipe.

Doublex Simplex is a high-pressure cast iron pipe, made by the famous Mono-Cast centrifugal method, possessing those desirable characteristics mentioned in the article quoted above. It is equipped with the Doublex Simplex Joint—a stuffing box type which will stand as high as 600 pounds pressure! Exhaustively tested and approved by impartial authorities. Thousands of feet now in service; thousands more on order. May we send you detailed description, specifications, prices, etc? Address your inquiry to nearest Acipco office.

AMERICAN CAST IRON PIPE COMPANY BIRMINGHAM ALABAMA

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The law of averages stops the disc everywhere an equal number of times — —

360° of Wearing Surface

NO one knows how the roulette wheel will stop next—(or at least they shouldn't know). But one thing is sure—over a long period of trials it will stop an equal number of times in every position.

And the law of averages distributes the stops on the Darling revolving gate discs in the same way. Every time the gate is closed the disc is in a different position—which affords a 360° wearing surface—hence —a greatly extended valve life.

But what really creates this true disc and seat contact is the perfectly plain interior construction, free from ribs and irregular shapes with no pockets for collecting scale and dirt that can cause the parts to stick and jam in operation.

The Darling Forged Steel Valves afford producers a safe valve where pressure is extremely high or unknown. The Darval Semi-steel valve provides long service for all general uses, both low and high pressures.

DARLING VALVE & MFG. CO.

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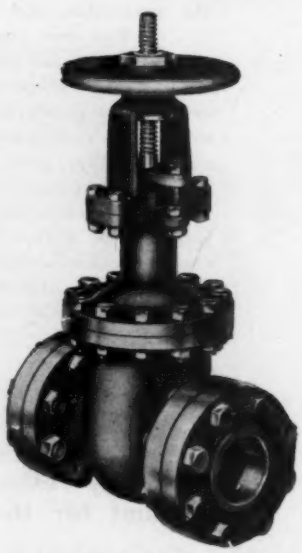
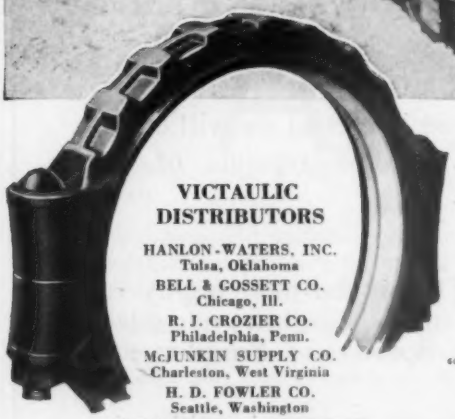
GATE VALVES



Darling Outside Screw and Yoke Forged Steel Flanged End Gate Valve, Dar-a-loy trimmed.

"For every joint on the line"



Study this tank battery connection—Victaulic Coupled

Ohio Oil Company eliminates the tedious features of pipe fittings by using Victaulic Pipe Fittings and Victaulic Couplings. If your lay-out does not line up exactly, what's the difference?—"Slap on" the Victaulic and let its tolerance and flexibility do the rest. A Victaulic Fitting will swivel in the Victaulic Couplings through 360 degrees and will be tight in any position. If your tank settles, the couplings still remain tight.

* * *

Victaulic Couplings are available in all sizes from ¾" up for vacuum and pressure — for steel, wrought-iron and cast-iron pipe. Mail coupon below for descriptive bulletin.

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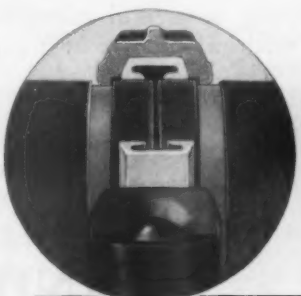
"For every joint on the line"



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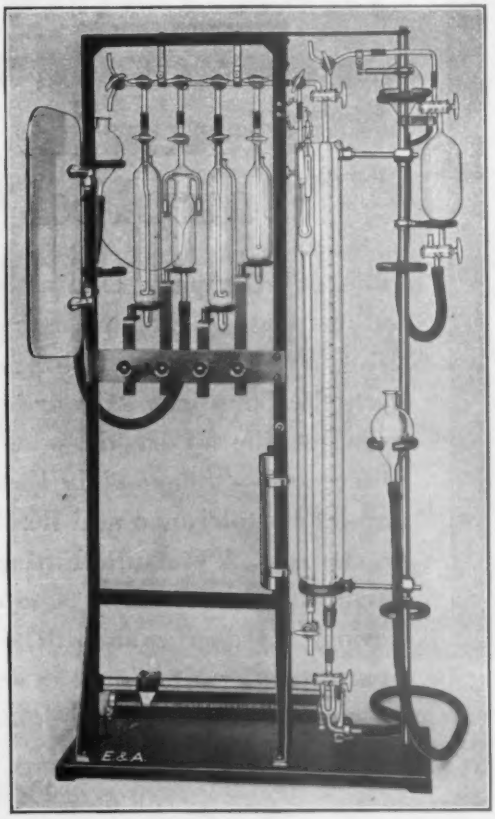
FOR OIL, GAS, WATER, SEWAGE, COMPRESSED AIR, ETC.

SHEPHERD
Gas Analysis Apparatus

for

Exact or Technical Analysis of Gas Mixtures by Combustion and Absorption.



A notable contribution by the Bureau of Standards to gas chemistry—the culmination of developments over a number of years by several Bureau of Standards Scientists.

The above Apparatus and Method was described by Martin Shepherd in the January Issue of the Bureau of Standards Journal of Research.

We urge Gas Chemists to investigate.

To those interested we will cheerfully forward reprints of the paper.

THE SHEPHERD GAS ANALYSIS APPARATUS is the most highly refined and perfected apparatus for analysis of gas mixtures brought to our attention to date. It offers **Extreme Accuracy, Greater Speed** and **Simpler** and **Easier Manipulation.**

The slow combustion method employing a special pipette greatly simplifies the determination of combustible gases without the use of a combustion furnace.

Pressure balance is indicated Automatically.

A limited number of apparatus of officially approved design and workmanship in stock.

Write for further particulars.

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EST. 1851 INC. 1897

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Third Avenue, 18th to 19th Streets **NEW YORK, N. Y.**

"That McWANE PIPE will CUT wonderfully"

~~~and it did!

A clean-cut pipe that cuts cleanly! That's McWANE. It is one of the good old-fashioned qualities that McWane casting processes (in green sand) retain when they produce cast iron gas pipe that is strictly *sand-cast*.

Straightness and uniformity, smoothness of walls, bells, and spigots, are of paramount importance in making cast iron gas pipe. In McWane gas pipe they are outstanding features.

In addition, McWane gas pipe has *strength*—30,000 lbs. average tensile; 2,600 lbs. average transverse. It is modern in its weights, yet old-fashioned in the ease and sureness with which it can be cut and tapped, as shown above.

Sizes, 1¼ through 12 inches. Standard lengths. Fittings.

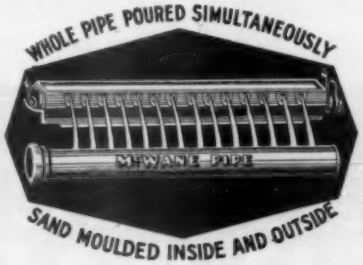
VARIOUS TYPES

McWane gas pipe is adapted to various types of trench-made jointing, being furnished plain ends, Bell and spigot, threaded, or cast for special forms of joints.

McWANE HIGH-PRESSURE GAS JOINTS

McWane recess-threaded (without couplings) and Flex-pan expansion joints enable gas companies to use rust-resisting cast iron pipe and gain high-pressure joints that are sure, simple, and economical. Write for McWane Gas Joints folder.

McWANE CAST IRON PIPE CO. BIRMINGHAM ALABAMA



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Steel Condensers for fresh water. Cast Iron Condensers for salt water. Circular, Rectangular or Oval Condensers, with uni or multi-flow gas passages, built to any capacity.

The Bartlett Hayward Company, with broad engineering experience has the facilities to design, fabricate and erect condensers for a wide range of capacities, pressures and services.

Coal Gas Plants
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Vertical Waste Heat Boilers
Purifiers
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THE BARTLETT HAYWARD COMPANY
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Salt Water and Fresh Water Condensers
B. H. Co. Vertical Centrifugal Scrubbers (Feld Type)
B. H. Co. (Genter Type) Thickener
Steel Tanks
B. H. Co. Westling Valve
Fast's Flexible Couplings

AMERICAN
GAS JOURNAL
Established 1859 Pioneer of the Gas Industry
Manufactured and Natural Gas

HENRY M. RILEY, *Editor*

Behind the Scenes

IN THE MIND'S EYE of the layman, to mention nothing of a not inconsiderable number of gas men, it is an intriguing spectacle to view the bringing of gas to their hearth from vast distances. Particularly is this so with natural gas. Far off is a derrick from beneath which a mere earth pore delivers its mobile fuel to a relatively slender pipe line which twists and turns its way cityward to feed heat to hungry furnaces and to supply thermal energy to domestic users. Then too, within the city gates a network of large and small pipes, supplemented by various regulators, valves and the like, contribute to the rounding out of the picture.

A worthwhile show to speculate on, one might opine, but what is behind the scenes; what are the "props," so to speak, that contribute so materially to its ultimate success?

First, never before were such high-grade distribution brains required. No longer will it suffice to plan pipe lines and their accessories by rule of thumb. No longer will the gas industry tolerate lines made too large in order that one will be sure that they will carry sufficient gas.

Next, the most modern and economical mechanical contrivances must be judiciously selected in order to speed up the laying of pipe.

Then too, leakage being something not to be countenanced, the sections must be made bottle tight by way of welding and highly developed couplings.

Further, it is necessary that the pipe be insured against premature corrosion by means of being coated or wrapped with materials of an anti-corrosion nature.

Lastly, a scientific study of pressure regulation and control must be the never-ending task of your up-to-the-minute distribution engineer.

These and many other attendant considerations are matters the distribution man must master in order to complete the picture of gas scientifically carried to the points of utilization. And, so interrelated is the subject, that the manufactured and natural gas man alike must be posted on all of these points. And, regarding the interrelation of the art of distributing gas, it is a fact that the natural gas man has supplied many good ideas to his manufactured gas brother and vice versa.

During the present Distribution Conference in Cincinnati it will increasingly be brought home to those in attendance that gas distribution has definitely entered an era of sound engineering investigation and achievement. More, they will appreciate that much remains to be accomplished. In other words, in all modesty we admit that we are at last doing a good distribution job. But, we know that work is going on behind the scenes that will guarantee a still better job.

Pleasing the Public Is Part of the Job

RECENTLY one of our utility acquaintances was complaining regarding the treatment given a contemporary in another concern. The substance of his claim was that a very able operating executive had been transferred to other work which had relatively little future, simply because of public disfavor. The whole situation, on further inquiry, developed points worthy of consideration by many utility men.

The demoted executive, for his transfer was really a demotion, had been unable to sense public wishes and conform his plans and policies accordingly. Apparently he had been very efficient by means which created from time to time unnecessary and unwarranted public antagonism. We are inclined to disagree with our friend who criticised the demotion. We cannot learn that it was occasioned by any ill advised prejudice of a superior. It was not the result of momentary ill humor, making the transferred man "the goat' 'for a single troublesome situation. It was apparently rather the mature judgment growing out of a constantly recurring difficulty occasioned largely, if not wholly, by faulty spirit in public relations.

We wonder if it is not fair to make the generalization that pleasing the public is always an essential part of a utility man's job. In fact, we would go so far as to say that it is an essential part of any business man's job whenever his business in any way touches the public or is affected even by public whim or fancy. In these days of keen competition it is more than true that the public wish. as well as public welfare, must be served.

New Opportunity to Gain Well-Trained Employees

A WELL-TRAINED member of a gas company staff, whether in office, works, or some division of the field service, is a better cooperator, a better public servant, and a very valuable member of a corporate organization. All too frequently men and women of large capacity do not realize to the full their opportunity in the gas industry for want of acquaintance with the mere fundamentals of the business. Now there is presented a new opportunity to individual workers and to company managements to correct such situation.

Rutgers University has prepared in cooperation with American Gas Association a well organized, comprehensive, and yet absolutely practical scheme for home study and supervised instruction of staff people. The cost of the course of study and the time required for its pursuance are very reasonable. The results will be of great value to the individual pursuing such course and to the company with which he is engaged.

The author of the two small text books used for this course, Mr. Charles E. Reinicker, has had peculiarly good training to fit him as an author of the handbooks. He has personally been in contact with every division of gas-company activity and writes with a background of 20 years of practical experience with the problems of the business. His material is presented in a simple straightforward style that will make the study of the course easy, even for those that have no background whatsoever in technical training. With the cooperation of his various associates and with the A.G.A. members participating in the drafting of the work there has been prepared material that is thoroughly dependable, strictly up to date, and sufficiently comprehensive to cover all important divisions of gas-company operations.

It appears that this work will have its greatest usefulness and the course its widest acceptance if a substantial number of companies will cooperate with their staff people in arranging for registration and participation in the course. It will be an excellent idea for mangements to offer to pay a half or more of the cost of the course, possibly gaging their percentage of payment according to the rating obtained by the student in pursuance of his studies. Each local group will find obvious and easy ways in which to arrange such cooperative financing for the course, which may be carried to completion at a very nominal cost per person enrolling.

In another way company managements may cooperate effectively. They may establish classes either at the company headquarters or at various convenient points in their communities where members of the staff taking the course may meet together for consultation with some of the more experienced company men, who will answer their questions, advise with them regarding their problems, and assist in making the course as attractive as it may be useful. It appears that the 21 chapters of the course can readily be covered in a like number of sessions. Thus, in any company where an intensive study system is desired it will require only two or three months to carry out the program. In other places, where conference once a week is necessary, the period would still not be unduly prolonged.

Registration for the course may be arranged individually or by groups at any time suiting the convenience of those registering. There is, therefore, no real obstacle to the realization of the large benefits of such training, except an indifference of the individual or the management.

Under the Banner of Humanitarianism

IN ANOTHER MONTH we will again have enjoyed the leavening influence of Mother's Day,—a day dedicated to one of the mightiest forces for good in shaping the destiny of mankind. At this time flowers will be worn in profusion, candy will move across the sweets shop counters literally in tons, and there will be an altogether generous show of filial emotion. This is as it should be, but, let us hope that such a heart's outpouring will not resolve itself into a mere perfunctory gesture but will rather stand as the hall-mark of a practice to be quietly followed out during the entire year.

Research will lead us into more profitable fields of gas utilization

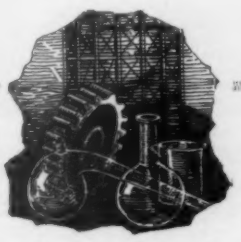
As most of us look back across the span of our existence there ever shines out, even in the most sordid, lives, the bright flame of the mother's constancy and sacrifice. In such a moment of reflection happy is the individual or institution who has contributed some ponderable effort and service toward alleviating her responsibilities and easing her burden.

In this connection our own gas industry can be pardoned in the show of a modicum of pride by way of its consummated desire to lighten housework and thereby contribute greatly to the mother's richly merited ease and comfort. Thus, for more than a century we have brought light in dark places; we have banished drudgery from the kitchen; we have advanced hygiene—which concerns the mother more than anyone else,—by way of a constant supply of hot water and the automatic gas househeating furnace; with the incinerator we have cleared the cluttered sidewalk and have thereby tidied up her castle, home. And we will go to still greater lengths, for around a definitely oriented corner comes housecooling to conquer one of the last outposts of discomfort in the home. It is well to realize that gas service during the passing years has declined in cost. This is of especial significance when one considers that the mother is the first one to feel the effects of a pinched purse and the last one to partake of the pleasures of an upward turn in the family's fortunes.

The matter of relieving the mother from drudgery is far-reaching, and a casual inspection of the mortality statistics bearing on childbirth will remind us in gratifying fashion that toil and worry saved during the precarious months preceding the bringing of future generations into the world unquestionably makes for general happiness and guarantees race stamina of the highest sort.

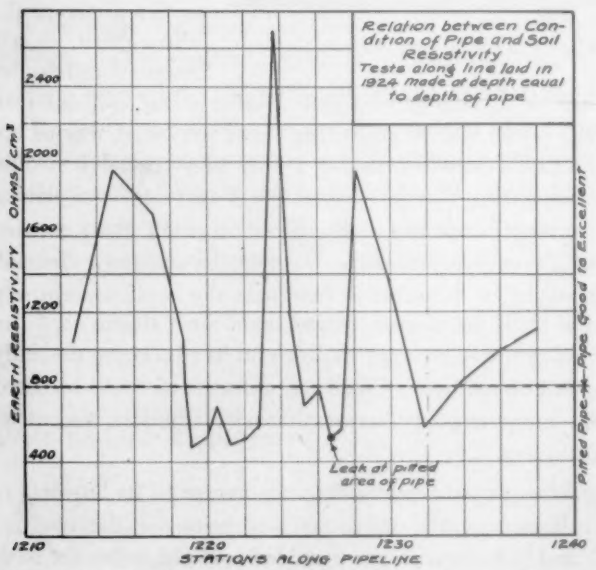
Gas companies throughout the country will doubtless tie-in their efforts with Mother's Day and due consideration will be given this happy period by way of appropriate window displays. In this regard it would seem fitting that window displays refrain from placing too much emphasis on the appliance itself along the line of giving it a prominent place in the window. Indeed, it might be desirable to eliminate the appliance entirely and build the display around some such slogan as, "The Gas Industry is happy to do its bit in alleviating the daily grind of mother." Then, on a neat card could be listed the many appliances contributing to the banishment of drudgery.

The gas industry by the very nature of its business is dedicated to the solicitous well-being of the mother. Hand in hand with her it strides forward under the banner of humanitarianism. Her grateful acknowledgment of this cooperation is a reward par excellence; a payment for service which far transcends financial remuneration.



Field Measurement of the Corrosiveness of Soils

THE character of a soil to a large extent determines the rate of its corrosive action on a gas pipe line. Hence it becomes important to be able to measure quickly and accurately this characteristic of the soil when a new line is being installed. An extended field investigation of the National Bureau of Standards has resulted in the development of apparatus and the formulation of a test procedure which enables distribution men to carry out such tests simply by measuring the electrical resistivity of most types of soil.



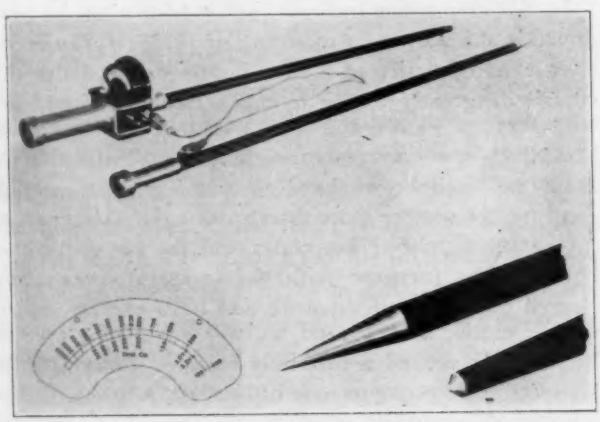
Example of variation in earth resistivity along a pipe line. Examinations show the pipe to be pitted in the soils of low resistivity and good to excellent in the soils of higher resistivity

The field investigation of the Bureau has included a study of the condition of a number of pipe lines which have been in place for several years. There seems to have been established a sort of three-cornered relationship between conductivity of the soil, the electrical currents which collect on and flow from the pipe lines, and the rate of corrosion of the pipe. Galvanic currents seem to accumulate gradually along the pipe in areas where the soil is of normal or high resistivity and to discharge in areas where the soil is of low resistivity, of course with attendant rapid corrosion. Apparently soils having a resistivity below 500 to 800 ohm-centimeters are likely to cause the most serious pitting of a bare pipe within a

Operator using apparatus in field

short time. Hence the identification of the highly conducting soil areas, "hot spots" as they are known to pipe-line men, is of great importance. Such identification is quickly and accurately made for a large majority of soil types with the Shepherd earth-resistivity meter, a development of the Bureau of Standards soil corrosion staff.

This apparatus is of extreme simplicity, as is evident from the illustration. It consists of two metal electrodes in the form of canes, which are coated except on their tips with an insulating molded Bakelite sheath. Press-



Shepherd Earth-Resistivity Meter

ing these canes into the earth at the point where an observation is to be made permits measurement of the soil resistivity by a simple direct-current test. The resistivity, expressed in ohm-centimeters, can be read directly from the indicating instrument dial on the handle of one of the canes.

When making field measurements it is essential to work only in the soil when it is not too dry, but such

condition is not difficult to observe, because any ordinary soil which is damp enough to pack in the hand will usually indicate nearly its full conductivity under such measurement. By boring auger holes into the soil to any desired depth and using longer canes, measurements may be taken at distances below the surface corresponding to the depth at which the pipe is to be buried.

Polarization difficulties normally encountered in measuring electrical resistivity of soils with direct-current methods are overcome by having the cathode, or negative electrode, of much larger area than the anode. By this means the current density on the cathode is so reduced that polarization effects are negligible within the short time during which the circuit is closed for each observation.

The Shepherd earth-resistivity meter of a type conforming to the Bureau of Standards designs is being manufactured and distributed by O. S. Peters, 930 H Street, N. W., Washington, D. C. This form includes a double-range scale on the instrument, one providing for indications from 100 to 500 ohm-centimeters and the other from 400 ohm-centimeters up to approximately 12,000. Thus more precise readings are to be had within the range where soils of most corrosive character are being tested, and yet the instrument is not unduly extended to reach soils of higher resistivity. As supplied the instrument is ready calibrated so that no calculation or correction factor need be applied in its field use. The direct-reading instrument is sufficiently precise to indicate within all significant limits the soil resistivity for the guidance of the engineer who desires to determine from such measurement where special precautions are needed in the protection of a pipe line.

Comparative Costs of Transmitting Gaseous & Electrical Energies

IN view of the fact that large amounts of energy in the form of natural gas are being transmitted over long distances, it is interesting to compare the cost of the transmission of energy in the form of high pressure natural gas with the cost of transmission of energy in the form of electricity at high voltage.

For purposes of such a comparison there are here set forth the direct operating and fixed charges on a double circuit steel tower electric transmission line, not including generating plant or substations, operating at 220,000 volts, having a tower line length of 262 miles with a maximum transmission capacity of 284,400 kilowatts and the same charges on a 22" and 20" welded steel natural gas transmission line, not including gathering lines or compressor stations, operating at an intake pressure of 400 lbs. per square inch, having a total length of 283 miles with a maximum transmission capacity of 75,000,000 cubic feet per day of 1,150 B.t.p. natural gas. Both of these lines are actual installations in California.

In both cases the life of the line is taken as 33 years and the depreciation annuity is calculated on the six per cent sinking fund basis. Also, in both cases the return on the investment is taken at seven and one-half per cent.

From the calculations made upon these basis, it is interesting to note that the cost of transmitting one million horse-power-hours of energy in the form of gas is $65.00, while the cost of transmitting the same amount of energy in the form of electricity is almost three times as much; namely, $190.00.

Comparison of Gas and Electric Transmission Costs

Item	Gas Line	Electric Line
Type of Line	22"-20" Dia. Welded Steel	Double circuit steel Tower
Pressure—Voltage	400 lbs.	220 K.V.
Length of Line	283 Miles	262 Miles
Max. Line Capacity	75 Million Cu. Ft. per day	284,400 K. W.
Ditto - Million H. P. Hrs. per year	12,291.4	3,321.8
Investment	$7,027,395.00	$7,211,000.00
Operating Charges:		
Maintenance & Operation	$ 198,100.00	$ 14,593.00
Depreciation Annuity	73,563.00	75,485.00
Return on Investment	527,055,00	540,825.00
Total	$ 798,718.00	$ 630,903.00
Cost of Transmission Per Million H.P. Hrs.	$65.00	$190.00

—C. G. Brown, Gas and Electric Engineer, Railroad Commission of the State of California.

How Consolidated Gas Company of New York Promotes Safety and Facilitates the night work of its Distribution Department by means of Floodlighting

IF I Had to Spend $150,000,000

R. S. McBRIDE
Consulting Editor, American Gas Journal

RECENT EXTENSION of long-distance gas and oil pipe lines has created entirely new economic problems for the investor as well as for the fuel-using industry. Comparatively little accurate scientific information is available on the consequences of soil corrosion of these pipe lines. A more comprehensive and highly accelerated investigation of these problems certainly seems to be warranted.

It is always a comfortable thing to imagine one's self very powerful. And for the present discussion it is convenient to assume that we, the author and the reader together, are sufficiently influential in the matter of pipe-line construction so that together we may determine policies without any question being raised as to their enforcement. Proceeding on that basis, let us see just what we should do with the huge sum of money which we must appropriate annually for "our" new pipe-line construction. For the last year or two, and for the next few years, it appears that we should have to build between 5,000 and 8,000 miles of such pipe line each year, let us say 6,000 miles on the average. The total cost of these lines will probably average about $25,000 a mile, considering large and small, favorable and unfavorable terraine, all averaged together. Thus our annual budget is to be about $150,000,000.

A Lopsided Condition

In the past we have been spending out of this budget very generously for good-quality pipe. We have paid whatever necessary for our rights of way and for the construction and installation of the lines. But we have spent comparatively little either to determine where or how much corrosion protection is needed or how to apply protective coatings if used. Indeed, it is not unfair to call us "extremely miserly" in this matter of protection of our big investment against destruction by soil corrosion.

The most elaborate study of the causes, extent, and control of soil-corrosion factors which has ever been made in the United States is undoubtedly the one now in progress under the auspices of the Bureau of Standards in cooperation with a considerable number of material-supply companies and with limited support by gas-utility and petroleum organizations. On inquiry we find that the American Gas Association and the American Petroleum Institute together are contributing not over $16,000 a year to this joint study as at present constituted. Our slide rule tells us that this represents an annual expenditure for national cooperative research on pipe protection equal to one hundredth of one per cent of the sum being annually invested for new construction. It does not require any profound thinking to show that so far as this coordinated cooperative study is concerned this insurance factor in our annual spending is negligibly small. Even though we add all the other expenditures made by the more influential groups in the pipe-line business, both gas and petroleum, it still requires several decimal places to express the ratio between the expenditure for corrosion prevention and our annual investment of new capital.

We can well reconsider this matter this month to see whether the ratio should not be radically changed for the coming construction season.

A Disturbing Factor

Suppose that we now convene as the finance committee of our imagined Super Pipe-Line Corporation. We have before us the annual budget for new construction. For the lines themselves, neglecting compressor stations, gathering and terminal facilities, and other accessory and for the moment unimportant equipment, we contemplate building approximately 6,000 miles of line this year with an average estimated cost presented to us by our engineers as $25,000 per mile. Under our comfortable assumption we have ample funds to provide this $150,000,000. In fact, we could readily raise ten per cent more if need be; you see our bankers are in quite a generous mood because of the low cost of money today. The problem looks simple. But when we dig into it we are quite disturbed by a report presented to our finance committee by one of the able young engineers who has been commissioned to inquire regarding protective coatings and soil corrosion. He tells us the situation somewhat as follows:

Present best knowledge indicates that it is extremely difficult to judge between the life of different classes of pipe. In a few soils cast iron is unquestionably better, in others wrought iron, and in still others steel; but by and large there is no sweeping generalization that impartial technical inquiry will warrant. He repeats to us in ac-

curate quotation the statement of one engineer who is undoubtedly among the best informed impartial investigators; who says, "So far as soil corrosion is concerned, you might as well pick your kind of pipe with your eyes shut."

But, we say, "We shall coat the pipe in soils where corrosion conditions are bad. Have you figured on that?"

Our informant then gives us the most disturbing news of all. He reports that it is practically impossible at the moment to secure agreement between even those who are supposedly most expert as to when pipe should be covered and when it is unnecessary. Furthermore, if it is decided to coat a pipe there is even more controversy than ever as to what coating shall be used, how it is to be applied, and how much it is worth in place. We demand at once to know what can be done about it. The answer is that we must wait for considerable further investigation, some of it involving extensive laboratory tests, some of it dealing with the burial of test specimens in various types of soils, some of it involving results of corrosion surveys or soil surveys on lines already in use. We ask for a summary of this situation and are shocked to learn that the answer will probably be available to us five or ten years hence, possibly not with entire convincingness even then.

The Facts

As we sit in our executive session following this report we are faced with the following facts:

1. We must spend between $100,000,000 and $150,000,000 annually for the next five years in order to keep up with the economic needs of the country for pipe-line service.
2. Because of lack of information we have to gamble on the life of these pipe lines and expect some of them to last not over four to six years, and, on the average, probably not over 15 to 20 years without considerable maintenance cost unless we can devise some effective protective scheme.
3. Our engineers cannot today give us any convincing answer as to the proper protective procedure, where such protection is needed according to the soils involved, or what is the real value of such protection when applied.

This is not a comfortable situation in which to find ourselves, but it represents substantially the actual facts today with reference to the gas and the petroleum industries.

After a few moments recess to catch our breath, we convene about the table, determined to do or die in the effort. Our stockholders will not tolerate inaction while we wait for a ten-year inquiry. Neither will they be content with reckless expenditures made without regard to the best available knowledge. And yet they do expect us to spend as rapidly as necessary to maintain our prestige in the field of fuel supply, making every dollar count as much as possible, and programming our work so that the risk involved in each year's expenditure constantly decreases. The answer then seems to be evident—

We must appropriate generously to speed up the acquiring of knowledge so that next year's spending will be subject to less risk than this year's, and in this year's work we must use the best present knowledge and then hope that the judgment of our technical advisors is not altogether bad.

This leads us to the question as to how we can speed up an investigation that normally would run for a decade or more before giving us satisfying and convincing data. Without being told, we quickly recognize that multiplying the expenditure on research ten-fold does not necessarily multiply the speed in the same ratio. But, we argue logically, if we can divert, let us say, only one per cent of our present expenditure from actual construction into investigation as to methods and improvements we may every year thereafter save many times one per cent because of the superior knowledge that we shall then have.

Suggested Procedure

The finance committee of our super corporation therefore promptly authorizes as its first move the appropriation for research and investigation of $1,000,000, the sole restriction on the appropriation being that those in charge shall strive in every way for speed in reaching conclusions, sacrificing what would ordinarily be called "efficiency" in research for this all-important element of time. A later session of our finance committee would then probably receive from our director of investigations a report along the following general lines:

We propose to enlarge the coordinated and cooperative study now being carried out jointly by the Bureau of Standards, the American Gas Association, the American Petroleum Institute, and the suppliers of pipe and coating materials. We are organizing at once a technical council representing the various groups, on which will sit only men interested in doing of research. Sales managers, with their proper and yet unavoidable commercial interests, will be invited to be absent. This council has tentatively organized the work in five major divisions. Generous allotments will be made for these projects as follows:

(a) *Fundamental Corrosion Phenomenon.*—This work will represent essentially laboratory inquiries to be carried out as now projected in several of the best equipped research institutions of the country already engaged on these projects. In view of the fact that such laboratory work on fundamentals cannot be greatly accelerated by new funds, it is necessary to appropriate only $100,000 of additional money, and all of this will be used simply to speed up and enlarge present investigations and not to start radically new inquiries.

(b) *Soil Classification.*—This study, made in cooperation with construction and pipe-line companies, will take full advantage of all present knowledge available in the Federal Government's Bureau of Chemistry and Soils. However, its main objective will be solely to classify soils with reference to their corrosive effect on pipe and furnish methods for identifying those soils quickly and yet accurately, preferably in the field, or alternately with the simplest effective laboratory test made on samples taken in the field. For this work it is doubtful whether more than $50,000 to $100,000 will be required.

(c) *Soil Surveys.*—This work will be done altogether in the field by parties who will undertake to correlate the identification methods now known or developed in division (b) with the principles and characteristics of the soils in the field, and will make studies along pipe lines which have been in place for some time past or which are to be constructed under our 1931 installation program. Each field party working in this division will require several men. The parties will be organized just as quickly as they can be staffed. Many of them will be headed by particularly competent college faculty men who can be engaged for the period of the summer vacation to work out under coordinated instructions the studies that are desired.

For each such party we allot $5,000 for equipment and $20,000 for salaries, traveling, and living expenses and incidentals. We assume that this will cover the entire cost for the head of the party, his technical assistants, and the laborers whom we must engage to do the heavy manual work in the field. The total appropriation in order to provide for at least eight such parties throughout the United States is $200,000.

(d) *Field Inspections.*—By making field studies of soils, corrosion and coatings on pipe lines that have been in place for from three to twenty years we hope to get the maximum amount of information within the minimum of time. For this purpose we shall organize field parties similar to those mentioned for the soil surveys. These parties with the cooperation of various utility and petroleum concerns will go out and uncover, or work with companies that are uncovering, pipe lines that have been in place for some time. We believe that twenty such parties could be profitably used, at about $25,000 each for the season, provided sufficiently competent staff men can be engaged to head and man them. Thus we have allotted half of our entire budget, or $500,000 for this part of the undertaking.

(e) *Coating Materials.*—A small staff, requiring comparatively little money because most of the investigation will be done by interested material-supply companies, will suffice for this part of our project. The purpose of the staff will be to secure an accurate definition of each type of coating material that is commercially available, to agree upon significant test methods for measurement of the pertinent properties, and to go as far as practicable toward the formulation of specifications for the materials and the description of adequate methods for the application of the materials in the field. $100,000 will probably suffice for this inquiry during the initial budget period.

Probable Benefits

On perusal of this five-part plan, we of the finance committee want to know what it promises to give us in the way of tangible, useful results for 1932 construction. We are assured by our engineers that they will not guarantee to solve the problem completely during the first year. They frankly confess that at least 50 per cent, possibly 75 per cent, of their expenditure on field inquiries may not have any significant value. And yet they give us the following most welcome reassurance:

"We expect at the end of the first year to be able to say certain things rather definitely. Among them:

"(a) We shall probably be able to define accurately and give methods for quick identification of, many of the soils in which certain, if not most, kinds of pipe can be placed without coating with the assurance of a reasonable life expectancy, judged on the score of soil corrosion.

"(b) We expect to be able to identify and describe, with quickly applicable test methods, a second group of soils in which it unquestionably will be necessary to apply protective coatings in order to insure life greater than four or five years.

"(c) We admit that there will probably be at the end of the year a substantial number of soils of doubtful corrosive characteristic and in which it will not be practicable to say with assurance that pipe must be coated or that it need not be coated. We are, however, hoping that such list would be comparatively small and that each succeeding season of investigation would rapidly reduce the number and importance of the soils of such indeterminate corrosiveness.

"(d) We shall expect to be able to define certain coating materials and prescribe methods for their application which will be adequate to insure a good job and reasonable life, certainly fifteen years, possibly 25 years, without failure through soil corrosion, even for extremely difficult soil conditions.

"(e) We shall be able to give at the end of the year a set of data which for practical commercial purposes will be substantially correct, enabling each subsidiary management to determine for itself which soils, except some of the indeterminate class, warrant coating of the pipe laid in them based on approximately how much the extra cost would be for such coating and what, approximately, would be the beneficial extension of life to be derived therefrom."

Going further into this matter our committee learns that present best coating practice indicates an approximate cost for heavy coatings of some demonstrated value not exceeding $2,000 per mile for pipe of substantial size. We are told that even in very bad soil conditions such an expenditure, representing less than 10 per cent increase in the cost of the pipe line, will increase the probable life of the pipe from five to at least 15 and possibly to 25 years without more than nominal cost for repair or replacement, insofar as soil corrosion is concerned.

We also learn that if we decide to survey every mile of pipe-line territory through which we lay transmission systems this can be done at very reasonable cost. We are told that a single competent field party can be equipped for not over $3,000 and that it can survey from 50 to 100 miles of line terraine per month for each party working. Such survey would contemplate investigation of soil conditions to a depth of four feet at least every hundred feet along the line to be run. In some areas where soil characters change rapidly and frequently test holes may be placed every 50 feet. Occasionally in very uniform soils test holes may not be required at smaller intervals than 200 feet. We are told that the probable cost of such work when well organized and properly directed would be between $100 and $200 per mile of line. Even with the present limited knowledge available for such field parties, it is believed that in at least 60 or 70 per cent of the cases their findings would be thoroughly dependable as a guide as to where coatings are necessary and where bare pipe is warranted.

A Reassuring Outlook

We ask how much more dependable such surveys, costing less than one per cent of the total construction expenditure, may be expected to be in another year. The head of our research council, who analyzed personally every detail of the budget, ventures a guess that in nearly 90 per cent of the cases of construction for 1932 they will be able to tell with certainty whether coating is necessary or not.

And not content with this, we ask how soon he can guarantee us 100 per cent certainty. He promptly answers, "Never." But he proceeds to qualify this by the explanation that for all practical purposes a three to five-year program of thorough, comprehensive inquiry ought to make the problem of soil corrosion a decidedly minor one in the pipe-line industry. That is, indeed, a reassuring situation, one in striking contrast with the present, in which every appropriation for pipe-line construction has as one of the two or three major uncertainties the question as to probable life of the pipe line

or the cost for maintenance of the line because of soil corrosion.

As a final act of our adjourned finance committee meeting we express the appreciation of the Super Pipe-Line Corporation to the advisory council on research. We recognize that we have given them funds rather generously for their investigations, but we believe that diversion of one per cent each year for the next few years is going to reduce the losses of our capital incident to soil corrosion by five to ten times this much each year after a three-year inquiry has been made.

After adjournment of our imaginary committee conference it may well be that a number of readers will share with the author the question—Why does not the pipe-line industry of the United States actually do something like that which we have above discussed? The figures chosen are very close to the practical facts. The probable benefits are, if anything, minimized in the above discussion. The main difficulty is, who will start this undertaking, or whether anyone has the vision and the influence to do so.

What's Ahead in the Light of Ten Years' Progress

DR. JOSEPH H. WILLITS, Professor of Industry and Director of the Department of Industrial Research at the Wharton School, University of Pennsylvania, at a recent meeting of the American Management Association in Niagara Falls selected the following among the points mentioned by him, as the most significant development in the field of personnel management in the last ten years:

1. Personal administration has ceased to be the "morganatic" wife or a "by-blow" of business management and has been built into the structure as an integral part of operating business management.
2. Personnel management and personnel managers have tended to become much less evangelical and sentimental and more ready to seek for and base their ideas and policies upon facts. Personal management is in process of becoming a more scientific thing.
3. An increased sensitiveness to the kind of job management has been doing has been developing and with this a tremendous effort through training to improve the quality of management. This has been particularly true on the side of training executives in personnel.
4. The psychology of American industry on the subject of wages has been changing. The attitude which seeks to make wages as high as possible rather than as low as possible is one of the most promising ideas so-called capitalistic society has produced.
5. The growth of employee stock ownership is of great importance.
6. The development of employee representation and union management collaboration means that we are starting the development of machinery which can make the ideas and policies of management come closer to the ideas and policies and feelings of the rank and file of workers.

On the basis of these changes Dr. Willits predicted that the most significant development in industry in the next ten years would include:

1. An increasing sense of social responsibility by industry,—and perhaps alongside of that,—an increasing participation by the state in the maintenance and establishment of minimum standards in industry.
2. The attainment of a greater measure of security from the hazards of industry and most particularly from the hazards of old age and unemployment.
3. A shorter working week.
4. An increasing concentration upon the quality and upon the methods of improving the quality of executive management and leadership in business.
5. An increase in research in economic and particularly industrial relations problems.
6. A change in the emphasis within industrial psychology by which greater attention will be devoted more directly to an understanding of human behavior in industry through the study of the emotions.

The Vicious Circle

HERE is a French allegory that points a moral worth remembering. A portrait painter sat in his favorite cafe sipping wine. His first small bottle finished, he was about to order another when his eye fell on a headline in the *Figaro,* "Hard Times Coming," so instead of ordering a second bottle he called for his check.

"Is there anything wrong with the wine?" asked the landlord.

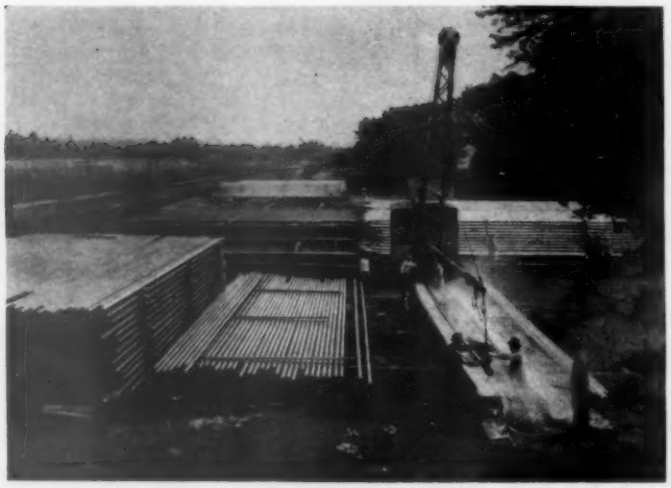
"The wine is good, but I did not order a second bottle because hard times are coming and we must economize," explained the artist.

"Hard times?" said the landlord. "Then my wife must not order the silk dress we planned, but must take one of cotton."

"Hard times?" repeated the dressmaker when the order was cancelled. "This is no time to expand. I must not make the improvements I had planned in this place."

"Hard times, eh?" said the builder when the couturière cancelled the building plans. "Then I cannot have my wife's portrait painted." So he wrote to the artist and cancelled the portrait order.

After receiving the letter the artist went again to his favorite cafe and ordered a small bottle of wine to soothe him. On a nearby chair was the paper in which he had read of hard times a few days before. He picked it up, read more closely, and found that it was two years old.—*The Kalends, Waverly Press.*



Showing double random lengths of 4" pipe being dipped in Bitumastic Enamel and whitewashed by means of crane with spreader boom.

Recent Progress in Pipe Protection

HENRY W. HOUGH

Wailes Dove-Hermiston Corporation

MATURE consideration of the present status of pipe protection practice leads to three important conclusions: (1.) Remarkable progress has been made during the past few years toward practical solutions of various pipe protection problems. (2.) The recent developments in this direction have been featured by better and more economical methods for the application of proven protective coatings. (3.) While the more progressive gas companies have been alert to the advantage of adopting these new economy measures, the industry at large still has far to go in making practical use of the best pipe protection practice available at the present time.

While much thought—and publicity—has been given the meritorious research programs undertaken by various associations and agencies concerned with corrosion and its prevention, perhaps too little consideration has been given to the practical and immediately available contributions which have been made by the established manufacturers of special coatings adapted for protecting pipe lines and distribution systems. It is my purpose to describe some of the more significant steps made recently, with the hope that more and more of the responsible engineers in the industry will take advantage of these workable economy measures to alleviate their losses from corrosion.

The background of these recent developments is interesting and should not be ignored. Following some years of theoretical discussion regarding the fundamental phenomenon of soil corrosion, there came a brief period of roseate optimism during which conjecture was rife concerning the prospective development of remarkable non-corrosive metals and alloys which might prove to be sufficiently cheap for general pipe line use. By the time it became clearly evident that this panacea would not be available for many years, soil corrosion had proved to be so costly that the everyday matter of preserving pipe lines was given more attention. This led, of course, to an investigation and wider use of special protective coatings for pipe.

It must be borne in mind that problems concerning the corrosion of steel are much older than the gas industry's worries about the untimely destruction of buried pipe. In the marine field, for example, corrosion has been a most serious problem since steel first was adopted for use in ships and marine structures.

It happens that the matter of developing special protective coatings for the prevention of corrosion in the marine field was undertaken by one or more established manufacturing concerns more than 70 years ago, in England. Engineers have long since established the fact that these protective coatings, built up from a selected coal-tar base and processed under rigid control, possess definite and enduring anti-corrosive properties.

When the protection of steel pipe in distribution systems and transmission lines for water, gas and oil became a matter of great importance, the engineers responsible for the construction and maintenance of these buried pipe lines were able to turn to the marine field for protective coatings which had proved their merit over a long period of years. However, in adapting these coatings which offered definite protection against corrosion, there was the problem of developing a new technique suited to the application of coatings to pipe for distribution systems and long pipe lines. This new set of conditions called for new methods and new equipment for application.

Credit Due Distribution Engineers

Much credit is due gas distribution engineers and the engineers of the long established coating manufacturers for wasting no time in the development of satisfactory methods and equipment to meet the need. It had been learned years before that the most effective anti-corrosive protection for metal surfaces consists of a priming coat of a special anti-corrosive solution or paint, completed by an application of a thicker coating of enamel, applied hot. The two types of coating were necessarily compounded from the same basic materials, in order to provide a good bond and a homogeneous coating.

Applying Bitumastic Enamel to main in storage yard of Kansas City Gas Company

It was not much of a trick to develop sufficiently rapid methods for applying the priming coat of solution, for that is done by brush or spray in about the same way paint is applied to any surface. However, it became evident that considerable attention must be given to properly cleaning the pipe before applying the primer. At one time the task of removing mill-scale, light rust, dirt, grease, mill lacquer and other foreign matter on the pipe surface presented quite an obstacle to rapid and economical application of protective coatings.

However, with the co-operation of the pipe mills, the manufacturers of special anti-corrosive coatings were soon able to effect the elimination of approximately 90% of the cost and effort of this "field cleaning" by having the customer specify a mill application or a shop coat of the proper priming solution. This practice also provided a better means of protecting the new pipe while it was in transit and in storage, or while strung on the ground along the right-of-way of a pipe line.

Developing Coating Method and Apparatus

To meet the need for a new method of applying hot coatings to pipe of small diameter (small, at least, compared with large water supply lines and the relatively flat surfaces coated in the marine field), the coating manufacturers developed a simple method and apparatus. The hot coating is poured on the top of the pipe and allowed to flow evenly and smoothly down the sides, while a canvas or carpet sling is used to spread the coating on the under surface of the pipe, as shown in one of the illustrations. Under all types of conditions prevailing in the gas and oil industries, this method has given such satisfactory results that it has been considered the standard method of applying hot coatings to mains, services and transmission lines.

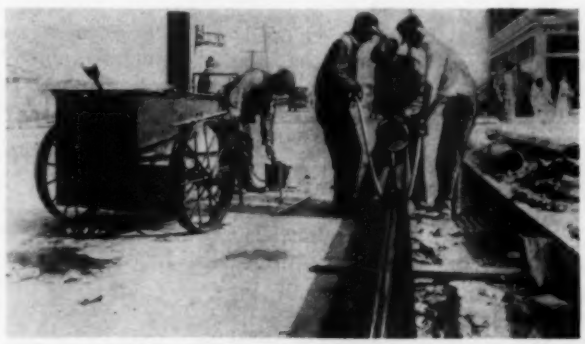
Special measures were required for the protection of pipe joints and couplings, both on transmission lines and in distribution systems. Here, again, the coating manufacturers met the need by developing special coating compounds possessing the extra elasticity needed for protecting joints susceptible to more or less movement when pipe is in the ground and when it is lowered into the trench.

Not only special coupling compounds, but also special coating apparatus has been perfected for accomplishing this task quickly and without a waste of material. Several types of coupling coaters have been used, but a recently improved coater is now being utilized for distribution system work. This device not only provides a better coating job with less waste of enamel, but it is light enough and small enough to meet the need for a coater to be used in bell holes where working space is necessarily very limited.

While the methods and apparatus described above have successfully served the purpose—if one may judge by their widespread adoption—further efforts have been instituted year by year to improve application methods and further guarantee adequate pipe protection while working toward reduced costs.

Most notable of the recent developments originating in the gas industry is the practice of applying bitumastic enamel by dipping the mains and services at storage yards and railroad sidings centrally located. When this method is followed, the pipe may first be dipped in a trough filled with the priming solution. However, prime painting can be accomplished with better results when the solution is well brushed out, rather than simply dipped. Whether the primer is applied by dip, brush or spray, it should be brushed out sufficiently to avoid heavy spots, runs, festoons and stalactites on the bottom of the pipe. No finished coating will endure if the primer is not applied properly.

When using the dipping method, the permanent protective coating of enamel is applied by dipping the pipe in a trough filled with the hot enamel. This coating hardens almost instantly. Frequently the enameled pipe is given an additional dip in whitewash for the purpose of reflecting the sun's rays in order to keep the black enamel from absorbing heat while pipe is in storage or strung on the ground before laying-in.



The commonly used "sling" method for coating gas mains and services

Storage yard dipping has proved to be a more economical method for protecting any substantial amount of pipe than the older methods, such as coating with slings in the field just before the pipe is lowered into the trench. Engineers operating small distributing systems, as well as those in charge of larger ones, have begun to recognize the economic advantage in adopting this system, which provides a more uniform coating with less expense for labor and handling and a far better chance of getting 100% protection than when pipe is coated in the field.

A particularly interesting dipping installation was constructed and put to use recently by the Boston Consolidated Gas Company, at Littleton, Mass. Some 120 miles of mains and services were dipped at this yard and one or two smaller dipping stations. All pipe was shop coated with bitumastic solution at the mill, in order to avoid the unnecessary expense and trouble of field cleaning. The priming coat of the same material was applied by brushing. All of the pipe was dipped in hot bitumastic enamel, and the mains were given an additional dip in whitewash.

For dipping double-random lengths of 4-inch mains,

a crane equipped with a spreader boom was used. The crane not only handled the two dipping operations easily and quickly, but provided the most economical means of moving the coated pipe to an adjacent storage rack and piling it in layers awaiting transportation by truck to the site of laying. While this type of dipping equipment gives best results when handling any quantity of double-random lengths of main of this size, the single-random lengths of 4-inch pipe can be dipped with ease by means of special end fittings, two men on each end handling the pipe.

Handling Does Not Damage Coating

It has also been interesting to note the experience of various gas companies and other advocates of storage yard dipping, with regard to the handling of coated pipe which must be trucked to the site of laying. It was felt by some that the coating would not be able to withstand the abrasion encountered by pipe during movement, transportation and stringing. However, experience with many thousands of feet of yard-dipped pipe proves that it can be loaded, trucked many miles and unloaded without suffering any material amount of damage, provided reasonable precautions are taken to keep lengths of coated pipe from forcible contact with other lengths.

Such chipping of the enamel as may result from a particularly sharp impact with a metal object (hammering the coated pipe with wood, such as a 2" by 4" does not affect the enamel at all), can easily be touched up by daubing the spots with hot enamel, before the pipe is lowered in.

Because no wrapping is used with the enamel, one can easily see the spots that require touching up and make the necessary repair. Obviously, this final precaution would not be feasible were the protective coating concealed beneath a wrapping which might not show any sign of serious damage to the coating. The only type of wrapping that can be used with safety is a field wrapping applied just before the pipe goes into the trench, and with the hard enamels now being used so extensively, the wrap is unnecessary. When laying coated pipe in cinder fill or rocky trenches, a loose wrap of wood veneer is used with highly satisfactory results, but this is seldom necessary.

The following data showing coating costs by the dipping method will be of interest to all gas company engineers:

Dipping Costs at Merrill, Wisconsin. (Merrill Gas Company)

	2-inch	3-inch	4-inch
Labor Cost per Lineal Foot: (Includes handling of pipe applying primer solution and dip in bitumastic enamel, digging bell holes and daubing joints)	$.0087	$.0128	$.0172
Material Costs: (Includes solution and bitumastic enamel, thinners, daubers and fuel)	.0179	.0273	.0324
Total	$.0266	$.0401	$.0496

Many engineers in the gas industry have been keenly interested in the remarkable advances made during the past two years in the application of protective coatings on the large-diameter natural gas transmission lines now being constructed from gas producing districts to far-away markets. Interest has centered in the use of the patented rolling rigs, upon which multiple lengths of the large pipe are mounted and revolved while workmen walking beside the revolving pipe pour and spread the hot enamel.

Rolling rigs for coating mains in storage yards have been proved highly successful, working on pipe as small as six inches in diameter, and in some instances even smaller. Those who have seen the progress of this operation in storage yards now use rolling rigs for coating mains of the larger size express amazement at the speed and perfection of the coating operation. This development offers an extremely rapid and economical means of coating mains of a size somewhat too heavy for coating by the dipping method, and no doubt will be included in the up-to-date storage yard along with the dip tanks for coating smaller mains and services. Here is *real* progress!

The foregoing description of some of the past, present and possibly future trends in pipe protection practice deal with matters of importance because of their immediate and practical value to the gas industry. However, there is also need for giving our attention and support to the far-seeing research programs now well under way through various co-operative agencies interested in soil corrosion and its prevention. Interest just now is centered in the comparative tests of pipe coatings, being made under the capable direction of Dr. Scott Ewing.

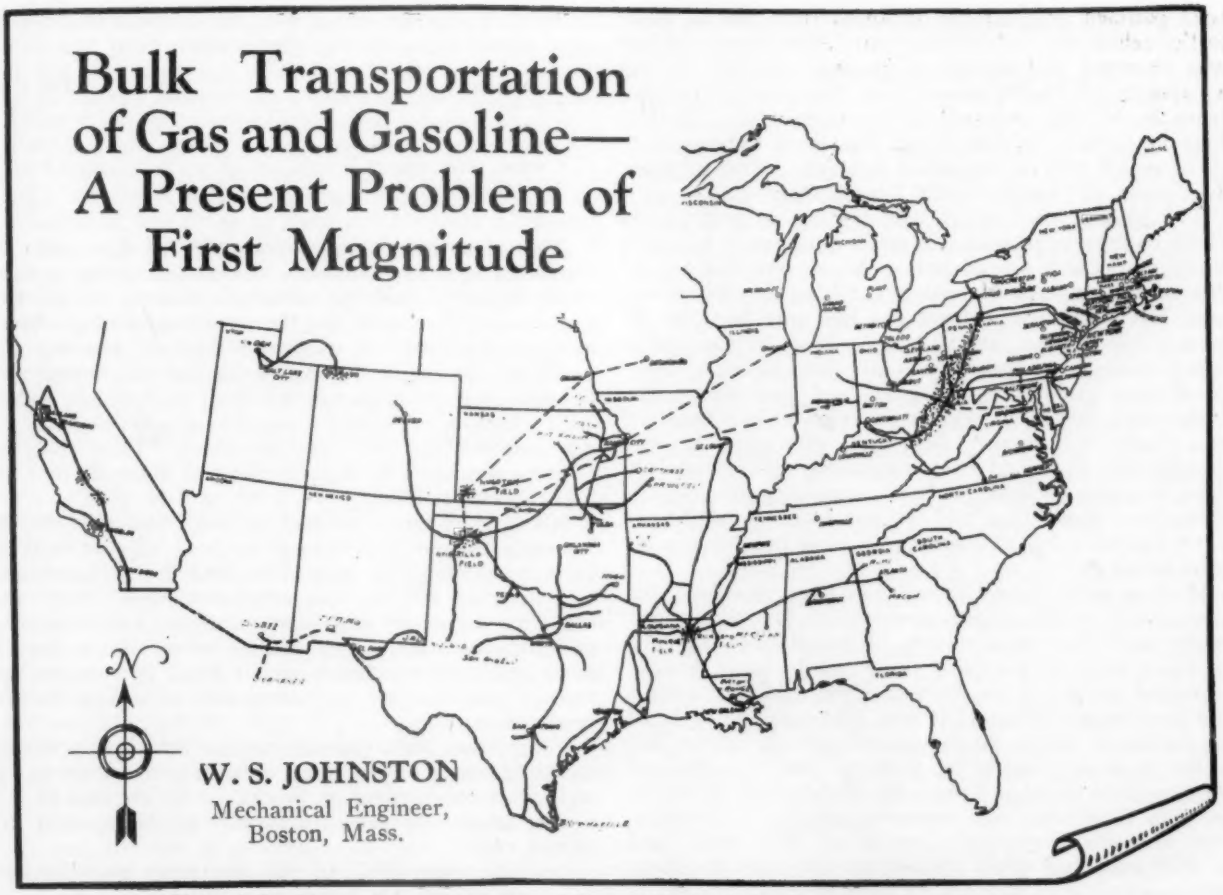
Experimental Specimens

Shortly after this article appears, at least a preliminary report will be made showing the results of the first nine months of burial for the numerous coating materials now being tested in pits located in many parts of the country. The rating of these coating materials in terms of their effectiveness according to various standards of measurements, was done at the Bureau of Standards recently by three outstanding experts in the field of corrosion research: Dr. Ewing, representing the American Gas Association; Mr. H. F. Peper, representing the American Petroleum Institute, and Mr. P. J. Richards representing the Underground Pipe Protection Institute.

The industry awaits with great interest the results of these tests, although recognizing that so short a period of burial as nine months does not tell a great deal, and admitting that the specimens tested probably were not coated under the same conditions or subjected to the same handling as would be the case in actual pipe line work. However, the results will give a reasonably reliable criterion as to the relative merits of the products tested, at least as to their relative effectiveness in the test locations.

Photos courtesy Wailes-Dove Hermiston Corp.

Bulk Transportation of Gas and Gasoline—A Present Problem of First Magnitude



W. S. JOHNSTON
Mechanical Engineer,
Boston, Mass.

Natural Gas Lines take on appearance of Electric Transmission lines throughout the country

IN the mechanical era which obtains extensively in this country, and more or less in practically all other civilized nations, engineers and engineering have played a role of major proportions. The problem which they have solved with the aid of science is that of production. That this particular problem received their attention first is attributable to the economic law of supply and demand, to furnish enough goods so none would carry a premium due to scarcity, and to keep the general price level within the reach of the majority. The secret of attaining any desired volume of commodity production is known.

But production alone is not sufficient. Any article without place utility is valueless. The market places obtain where the consumers are, and not at the source of supply. Engineering talent and science have devoted much thought and consideration to the second major problem, i. e., distribution. Witness the first steam railroad trains that make 10 to 15 miles an hour on strap iron fastened to stringers and the electric trains of today running 90 miles an hour on 120 pound rails. Then there is the advance in steamship design that makes possible a crossing of the Atlantic Ocean in 4 to 5 days instead of nearly as many weeks. For short hauls and hauls that are getting to be not so short, there is the motor vehicle capable of equaling the speed of an express train for passenger service and the load carrying capacity of the European railroad wagons. The air, too, has been utilized to transport man and his merchandise in both lighter and heavier than air machines at heretofore unheard of speeds over both land and water.

However, great as the advance has been in transportation facilities to aid distribution there exist opportunities for improvements. New methods may be devised, thanks to our imaginative genius, and the vast resources of a great country intelligently applied. In the past five years a revolutionary change has been made in the long distance transportation of bulk material in large quantities that had its inception years ago on a much smaller scale. It makes available from the point of origin what heretofore was used only locally in comparison. It is the far flung application of a principle and a method amplified and improved upon to give place utility to commodities that may be so moved.

In 1821 near Fredonia, N. Y., natural gas was found and its nature and usefulness were soon discovered. History does not definitely record the fact, but doubtlessly this first known source was made available to a number of users by piping the gas to nearby farms and then into the city of Fredonia.

As pools of natural gas were found elsewhere in the country, pipe lines were laid to the nearest markets. Ten years ago the longest natural gas pipe line had a length of 100 miles. This year will witness the completion of a line 1,000 miles long. Its capacity will be over 200 million cubic feet per day delivered to the Chicago industrial district. In 1900 the national annual consumption of natural gas was only 500 times this quantity.

Because of the development of pipe lines in the natural gas industry, the oil industry has reawakened to the possibilities afforded by the high pressure, large capacity lines now available. For years crude oil has

been pumped considerable distances from the oil fields to the refineries. About two years ago a crude oil line was reversed and became a gasoline carrier. It has a capacity of 25,000 barrels per day moving gasoline from the Atlantic seaboard out to eastern Ohio. In 1930 four important gasoline trunk pipe lines were started, all of which will be completed this year. One of these lines alone will handle 65,000 barrels daily.

The present method of transporting natural gas is likely to be revolutionary in other fields so it is worth while to become acquainted with the past history of this valuable source of energy. Although discovered over 100 years ago, natural gas has only been in extensive use for the past 50 years. Most of the earlier supply came from the Appalachian field in Ohio, western Pennsylvania, West Virginia, and Kentucky. The wells were drilled to depths of from a few hundred to a couple of thousand feet. At one time it was thought the field had been practically exhausted but, since it is now possible to drill to much greater depths, it has been found that only the gas from the shallower levels has been drawn off and that more extensive pools exist below them.

Modern drilling machinery has been developed in other fields which afford reserves of far greater capacity than the Appalachian. Natural gas has been used in California for many years and the most recently exploited fields are the Buttonwillow, Kettleman Hills and Los Angeles Basin. It was discovered in three of the southern states almost simultaneously about five to ten years ago, and today there are the Amarillo and southwestern fields in Texas, the Monroe and Richland fields in Louisiana, and enormous pools in Oklahoma. Pipe lines distribute gas from all of these fields, and in 1928, the last year for which data are available, they supplied over 90% of the natural gas consumed as itemized below:

State	Millions of Cu. Ft.	Per Cent of Total
Oklahoma	321,000	20.5
Texas	302,000	19.2
California	246,200	15.7
Louisiana	227,800	14.5
West Virginia	163,000	10.4
Pennsylvania	99,500	6.3
Ohio	56,300	3.6

As the amount of the various reserves has been determined and transportation facilities improved and extended, national consumption has grown apace as shown below:

Year	Millions per Cu. Ft.
1900	100,000
1910	509,000
1920	798,000
1923	1,007,000
1926	1,313,000
1929	1,850,000

From 1920 to 1925 the average annual increase was 9.8%, for the next four years it was 11.1%, and in 1929 about 18%. In ten years the increase has been 132% compared with 123% increase in the fast growing electrical industry.

Segregating the consumption in the last decade between industrial and domestic uses, the increase in the proportion devoted to industrial purposes is apparent.

Year	Industrial	Domestic
1920	64%	36%
1923	73%	27%
1926	78%	22%
1929	80%	20%

Further segregation of the consumption in 1928 by uses shows the following distribution:

Industry	Per Cent
Oil fields	36.6
Domestic uses	20.5
Industrial establishments	19.5
Carbon black plants	11.2
Oil refineries	7.3
Electrical industry	4.9

The oil industry used almost 44% of the total. In the fields it is used to force the oil out of the ground under pressure while the refineries utilize it as fuel. Domestic uses accounted for the next largest single block of gas consumed. It was used for both cooking and residence heating, and domestic customers are desirable because their demands are not likely to fluctuate widely with changes in business conditions which affect the consumption of the industrial users. Then too, the revenue produced by domestic uses is derived from the higher price brackets.

It has been estimated that in 1930, well over 20,000 industrial plants used natural gas. It appeals to them as a cheap fuel, easy to handle, flexible in control, and as presenting certain economic advantages. Steel and metallurgical plants and those industries requiring heat under perfect and exact control at all times, find it more satisfactory than other fuels. It requires no storage facilities nor the investment of capital in fuel reserves.

The carbon black industry at one time was probably the largest user of Louisiana natural gas in the exceedingly wasteful combustion process of the channel plants. Conservation measures are rapidly curtailing their activities.

In 1928 about 10% of the electricity generated in the country was produced from natural gas fuel. It has been used for almost ten years in California, and one of the largest power plants utilizing it is that of the Southern California Edison Company at Long Beach. Numerous small plants in Texas have used natural gas for about as long a period. Probably the largest central station using gas exclusively is at Sterlington, Louisiana, in the heart of the Monroe field. With the advent of trunk gas lines, power plants far from the gas fields now use this cheaper fuel, whereas expensive coal was heretofore their only available source of heat.

Economics—The Determining Factor

Now as to whether or not the construction of a natural gas pipe line is justified, only the economics of the project can determine. However, there are some factors that may be discussed. A long line is not warranted unless the field shows a probable life of at least 20 years. The life span can be calculated fairly closely. When gas sands are first opened a field has a certain initial rock pressure. As gas is taken off, the rock pressure decreases in relation to the volume withdrawn in accordance with the physical law governing the interrelation of the pressure and volume of all gases. Knowing the volume used and the pressure obtaining before and after this withdrawal, it is easy to compute the original volume and, on the basis of a predetermined annual drawdown, estimate the life of a field. In this manner it has been determined the Amarillo field has probably the largest known reserves, covering about one million acres of proven gas land with a capacity of 300 million cubic feet of gas a day for 70 years or so. The Monroe and Richland fields

are now delivering about twice this much, at which rate they will have a life span of 16 years. Drilling into deeper strata reveals more gas sands in these fields, so additional reserves may prolong their life. In the Appalachian field where experience based on a long past history permits of more accurate calculations, a life of about 25 years is expected. Doubtless as other fields mature, it will be possible to determine their life expectancy, but there is always the chance of drilling deeper in the present fields and finding new strata of gas sands. Fortunately the wasteful use of gas in the producing fields is fast being eliminated through the conservation methods adopted by a number of states. The amount of withdrawals is also limited to a certain percentage of the initial open flow from each individual well.

Natural Gas Consumption Trends

On the other hand there must be a market for the gas. Statistics have been given showing the growth of consumption over a period of years and the wide spread distribution of this consumption. The trend of consumption by all users is upward. Gas companies took about 50% more natural gas in 1929 than in 1928. Public utility power plants increased their consumption by about the same percentage. In 1929, natural gas constituted 77% of the total volume of all gas used. While production has increased, the market is far from the saturation point. Pipe line companies seek to serve industries operating continuously day and night as a load of this character gives a greater ratio of line use to line capacity.

The spread between field prices of natural gas and the amount paid by ultimate consumers covers the cost of transportation, including the expense of recompression on long lines; maintenance costs on the lines and compressor stations; fixed charges on the invested capital; corporate overhead and profit.

Developments in pipe manufacture and line construction of comparatively recent years are interesting. The first of the long distance lines is that from the Monroe field across the Mississippi River to Baton Rouge, 170 miles long, laid down in 1926. It was extended 90 miles to New Orleans the following year. At that time the line pressures were of the order of 350 pounds per square inch. Lap welded pipe was used and the stresses in the metal of the pipe wall did not exceed 10,000 pounds per square inch. Today the market affords better pipe, either seamless steel tubing or electric weld pipe that may be stressed from 18,000 to 20,000 pounds in the wall metal, thus permitting the use of 800 pounds line pressures in pipe sizes up to 26 inches diameter.

Natural gas contains about 1,000 heat units per cubic foot, none of which is lost by compressing and pumping it through pipe lines and, on a well constructed line, there is but a negligible loss in volume due to leakage. Natural gas is often wet with gasoline and this casing head gasoline is extracted by recovery plants located in the fields. From one to four gallons is removed per thousand cubic feet of gas, decreasing the heating value of the gas by as much as 8%.

There are over 80,000 miles of natural gas pipe lines in this country. The map shows the territory covered. Oil trunk pipe lines aggregate a greater total mileage, but cover about the same sections, the California coast from Los Angeles to San Francisco, and the mid-continent fields to the Great Lakes and North Atlantic states. Gasoline pipe lines are a new development; there are only some half dozen or less under construction or completed, but they appear in about the same territory as the gas and oil lines. Thus it is evident a new means of transportation and distribution is at hand, sufficiently developed to assume definite form and take its place with other agencies for like purposes. The railroads recognize this fact, having felt the effect of decreased car loadings of crude oil and gasoline to say nothing of the loss in coal freight in many sections where natural gas is now available as an abundant and cheap fuel. The National Association of Railroad and Utilities Commissioners has recently urged the Congress to enact appropriate legislation for the regulation of the price of natural gas transported in interstate commerce.

Gas Lines Should Help Business

Pipe lines in general and those used for natural gas in particular, are the first contribution of the engineering profession to a solution of the distribution problem. They give place utility to cheap fuel at the minimum of cost. The extent that this new means of bulk commodity movement is adopted and used by other industries and for other products will determine the amount of profit realized from this latest achievement. It is the first indication that in the next decade the progress in solving the distributing problems of industry will be comparable with the advances made in the past in manufacturing and production by engineering and science. To the degree that lack of adequate and properly coordinated distribution leads to business depression, will the latter be mitigated in the future through the methods developed.

Effect of Properties of Petroleum Wash Oil in Removal of Light Oil from Coke Oven Gas

TROUBLES commonly encountered in the use of absorbent oils are described and tests ordinarily made on these oils are considered from the standpoint of their relevancy to service requirements and their bearing on sludge and deposit troubles. Tests of value are listed, along with a new test for evaluating the stability of wash oils toward oxidation. Those found to be of little or no value include the much discussed "olefine content."

Evidence is given to show that "olefines" are not responsible for distillation losses or sludging in decanters, the latter being eliminated by maintaining as low specific gravity, viscosity and emulsion tests as possible. Scrubbing tower deposits are primarily due to coal derivatives held in the oil, altered by oxidation and polymerization. Use of more stable oils seems to reduce rate of formation of deposits in towers.

A short laboratory absorption test indicates little difference in light oil yield among oils varying considerably in properties. Results are somewhat in favor of use of oils of higher specific gravity, viscosity and H_2SO_4 absorption, although such oils generally give sludging troubles. Hence absorbing efficiency is usually of secondary importance in choosing wash oils.

—H. R. Mathias, before American Chemical Society, Indianapolis, Mar. 30th to Apr. 3, 1931.

Industrial Furnaces For Gas

III—Special Furnaces For Metal Melting And Reduction

LAWRENCE E. BIEMILLER

Supervisor Fuel Sales, Consolidated Gas Electric Light and Power Company.

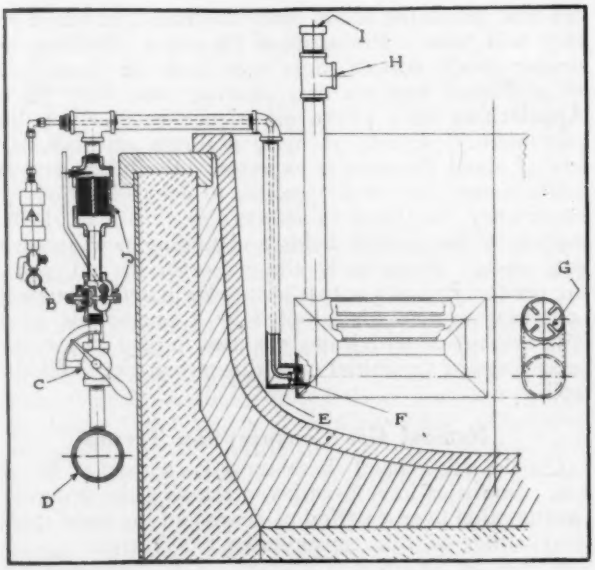
THE first two articles of this series have considered standard furnaces of different types, used for melting a large variety of metals. By standard furnaces we, of course, mean furnaces which are manufactured in sufficient volume to be considered a regular product of the concern making them. As a general thing any heating operation which is done in many plants with standard furnaces, will be done in some plants on a very large scale which necessitates usually much larger but, in any case, individual special furnaces built to fit the operating conditions of the particular plant in which they are used.

There are many special built gas furnaces which can be considered lineal descendants of the furnaces discussed in the first two articles. There are too many such furnaces to do other than mention a few typical examples of them here. It is important that the reader consider these furnaces and those treated in the first two articles in correct relationship. In any industrial market there will be a large number of metal melting operations for which small standard furnaces are proper. In the same territory there will be similar operations requiring special furnaces. It is essential that the industrial gas engineer, who can sell the former furnaces, be able to recognize the operation requiring the latter furnaces. He can then secure the aid of builders of such special furnaces in securing the installation of the proper equipment.

This article will consider special furnaces in the printing industry; for metal coating, such as galvanizing; and, for metal reduction.

Sterotype Pots

The high speed production of the modern newspaper necessitates the use of a dependable source of heat in connection with the melting of soft metal at a temperature of 600 to 650 to form plates from which the paper is printed. Originally newspaper printing was done from type set so as to make a plane surface. With the development of rotary printing presses it was necessary to get the form from which the printing was done in a curved surface.



Cross-section of Stereotype Pot—Showing Kemp Immersion Burner

A—Fire Check
B—Pilot Manifold
C—Index cock
D—Main burner manifold
E—Pilot
F—Main burner drilling
G—Heat absorption fins
H—Vent
I—Lighting port

First, the matter to be printed is set up on a plane surface and this is transferred to a flexible matrix, which is bent into the desired curved surface. Then a curved plate, called the sterotype plate, is cast against this matrix. This plate then can be used upon a cylindrical press. Small amounts of molten metal are used in connection with forming the original plane surface. This metal is in a small pot connected to the linotype or monotype machine, as the case may be. These pots are largely heated by gas, though many installations need to be modernized with correct burner, automatic temperature control, and suitable insulation and venting, if the use of gas is to continue. Recently in one plant the monotype pots, each containing about 50 pounds of metal, were so modernized, and the gas consumption dropped nearly fifty per cent, with working conditions greatly improved.

Original Stereotype Mailing

Very large amounts of molten metal are used in the casting of the stereotype plate for one edition of a large newspaper. Originally such melting was done in oval fired pots, and next, these pots were converted to gas by the use of atmospheric burners. With increased speed of printing it was necessary to improve upon this equipment. A modern automatic autoplate machine pumps, casts, cools, and saws off the tail, of 4 stereotype plates per minute, each weighing 58 pounds. Since two of such plate machines are supplied by one eight ton stereotype pot, it will be seen that the demand on such a pot is very heavy.

With such an automatic caster the problem is to get sufficient heat absorption with the usual design and size of pot. This has been solved by the C. M. Kemp Mfg. Co., by using their patented immersion burners which are immersed in the molten metal, and have the air gas mixture burnt in them. An eight ton pot

C. M. Kemp Mfg. Co. Immersion Burners on Zinc Melting Kettle for Die Casting

has 10 horizontal elements, each burning 115,000 B.t.u. These elements are made of three inch diameter extra heavy steel tubing, welded in the form of a rectangle, and are located about 1½ inches from the bottom of the pot. In addition, there are four vertical elements, one in each corner of the pot, for breaking through when the metal is solidified. The main burners are automatically controlled, so as to maintain the temperature constant within 20 degrees even under conditions of heavy draw. The pilots burn 75,000 B.t.u. of gas per hour. The space between the pot and furnace setting is filled with Sil-O-Cel C-3 insulation. The pot is well hooded and this hood is vented into a chimney. As a result, this installation gives ideal working conditions as well as the low fuel consumption, which follows:

	Pounds Metal Cast per 1000 B.t.u.	Pounds of Metal Cast
Maximum 15 minutes	22.2	6264
Maximum hour	20.3	18000
19 hour casting period	13.2	125570
Average for 24 hours with 19 hours casting period	12.2	125570

When such high speed automatic castors are not used the amount of heat required from a given size pot is not as great and external firing can be satisfactorily used. With suitable nozzle mixing burners using air at 9 ounces and gas at several inches pressure, it is easy to burn 1,300,000 B.t.u. of gas under a nine ton pot, and to automatically control the temperature within 30 to 40 degrees. The exterior of this type furnace can be covered 2½ inches of Sil-O-Cel. The combustion space is filled with hollow tile, then seven inches of C-3 Sil-O-Cel insulation and 2½ inches of firebrick. The pot is well hooded, with flues insulated. As a result the atmospheric pilots, burning 100,000 B.t.u. per hour, will keep the drop in pot temperature to 480 from an initial temperature of 610, over a 16 hour holding period. The typical operation of such a well designed externally fired 9 ton pot is:

	Pounds Metal Cast per 1000 B.t.u.	Pounds of Metal Cast
Maximum 15 minutes	15.6	4,800
Maximum hour	14.4	15,960
7 hour casting period	10.7	45,280
Average for 24 hours with 7 hour casting period	7.1	45,280

Galvanizing Kettles

One of the most important metal melting operations, and one for which gas is extensively used, is galvanizing. This consists of maintaining a large bath of molten zinc into which metal objects are dipped to secure a coating of zinc, valued for its corrosion resisting properties. Gas has particular value for heating galvanizing kettles because of the ease of obtaining good temperature control and good heat distribution. The proper temperature in the metal bath is absolutely essential, in order to obtain the desired thickness of metal coating, to keep dross at a minimum, and to give maximum kettle life. Good heat distribution greatly increases kettle life. Long kettle life is essential since kettles are expensive and the costs of installing them, and the costs of lost production while doing so, are very high.

Typical Galvanizing Kettle made by The Surface Combustion Company

Galvanizing kettles come in all sizes from 2 by 3 by 1½ feet, to 12 by 80 by 4 feet, but the average size is about 8 by 10 by 3 or 4 by 3½ feet. The usual construction of a kettle consists of 4½ inches of fire brick and 4½ inches of a high grade insulation, such as Sil-O-Cel, contained in a sheet metal case. Recently there has been a trend to thicker insulation, up to 10 inches. Usually a large number of proportional mixing blast burners are used, firing on both sides of the kettle. Atmospheric burners can be used during non-operating holding periods. In order to get good kettle life the maximum heat applied to the kettle should not exceed 12,000 B.t.u. per hour per square foot of exposed side.

The following is the heat balance of such a kettle 6 by 2½ by 4 feet,

Time operated—8 hours 25 minutes
Temperature—Start 840 F—Finish 850 F
Flue Gas Temperature—1000 F.
Capacity of kettle—25,300 pounds.
Steel galvanized—5451 pounds
Spelter used—1175 pounds.
Area of walls—108 square feet.
Gas used—2,150,000 B.t.u.

Item	B.t.u.	Per Cent.
Heat in steel	480,000	22.3
Heat to melt spelter	152,200	7.1
Increased heat in bath	25,300	1.1
Flue loss	451,000	21.2
Wall loss	214,000	9.9
Loss from top of kettle	827,500	38.4
Total	2,150,000	100.0

This shows clearly the large loss due to radiation from side walls and top of kettle. If more material were put through the pot these losses would not be such a large part of the gas supplied. When not operating, that is, holding at 820 F., the following is the gas required:

	Without cover	With insulated cover
Gas per hour—B.t.u.	121.320	78,150
Gas per sq. ft. per hour—B.t.u.	8085	5175

This shows the heat required for holding temperature during non-operating periods is quite an item. It is clear that the unit cost of galvanizing decreases rapidly with increased length of working day.

Pot Tinning Furnace made by The Surface Combustion Company

Much galvanizing is still being done with coke fired kettles. Due to difficulties of control, such kettles cannot be operated as economically as with gas when all items of cost are evaluated. The industrial gas engineer should be able to prove the economy of gas if he uncovers all the costs due to dross, short pot life, incorrect thickness of metal coating, as well as the usual costs connected with the use of a solid fuel. Large tinning furnaces are similar in many respects to galvanizing pots, and are equally well adapted to gas firing.

Metal Reducing Furnaces

Another type of heating operation that may well be considered here, is the reduction of metals. The metal reducing furnace pictured here is 18 feet long and is fired by 34 burners, firing on opposite sides. The burners are divided into four temperature zones, each individually controlled. The furnace contains a carbofrax tile muffle and supports, a combustion chamber, inside of 4½ inches of firebrick, backed up by Sil-O-Cel insulation varying from 9 to 13½ inches in thickness, all held in a metal shell.

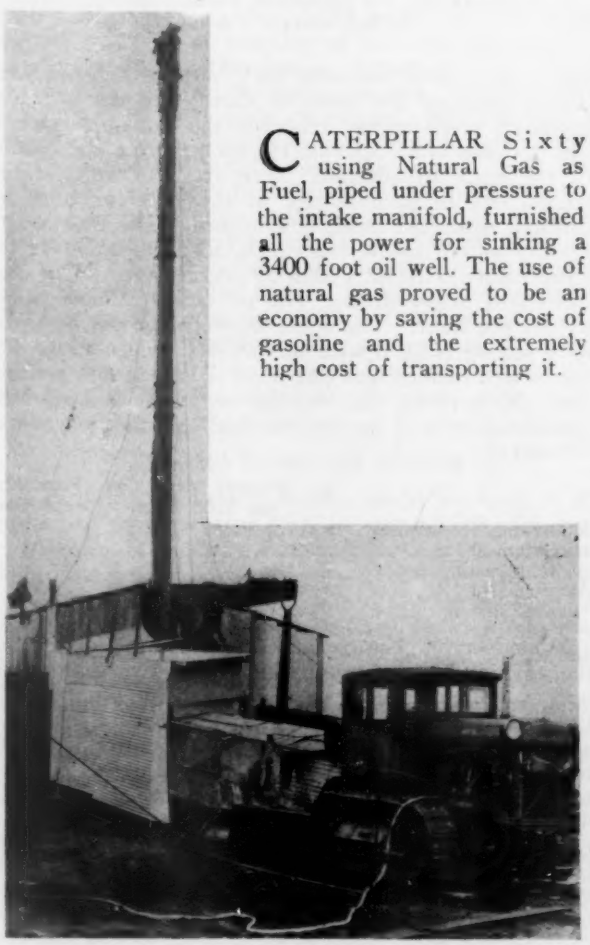
The oxide to be reduced is passed through nickel chromium tubes in small carrier containers advanced by hand. These tubes are filled with an atmosphere of hydrogen which is maintained at a definite desired pressure, while the tubes and the oxide in them are held

Metal Reducing Furnace made by The Strong, Carlisle and Hammond Co.

at temperatures up to 2000° F. Here gas is used because of the ability to obtain the desired heat distribution, and to attain and hold the desired temperatures, with minimum furnace upkeep costs.

(*Series Continued in May Issue*)

Natural Gas Assists in Sinking Oil Well



CATERPILLAR Sixty using Natural Gas as Fuel, piped under pressure to the intake manifold, furnished all the power for sinking a 3400 foot oil well. The use of natural gas proved to be an economy by saving the cost of gasoline and the extremely high cost of transporting it.

Some Common Errors of Gas Analysis and Their Remedies

MARTIN SHEPHERD
Chemist, Bureau of Standards,
Washington, D. C.

Introduction

THE accuracy generally attained in gas analysis is considerably less than the accuracy usually attained in other types of analyisis. There are at least four factors contributing to make this so. They are:

(1) Faulty design of apparatus.
(2) Incorrect analytical procedure.
(3) The use of methods which are not sufficiently accurate.
(4) Indifference to improvements on the part of many analysts.

The last of these factors arises from an insidious psychology, and is consequently beyond the province of chemical science. A recognition of the symptoms of the case may be of possible help, however, when it is presented to the psychiatrist. Perhaps, in the very beginning, analysts felt that the accuracy of an ordinary volumetric gas analysis should compare favorably with that of a carefully conducted gravimetric analysis, which yields results significant to hundredths of a per cent. The nature of ordinary apparatus and methods of gas analysis makes this impossible, and a matter of simple arithmetic should convince the gas analyst of this fact. And yet the tendency is to report an ordinary gas analysis to the second decimal place when it may have been good to some uncertain figure in the first decimal place. Apparently the justification is that everyone understands this, and no one is fooled. At the same time the analyst is apt to feel that unless his results are reported to hundredths of a per cent, the analysis has no dignity. But as long as this situation persists, there will be no great urge for improvement where, as a matter of fact, it is badly needed.

Concerning the third of these factors, the gas analyst finds himself in the position of one who has an excellent excuse but is reluctant to use it. The excuse has been nicely presented by E. S. Shepherd,[1] who enumerates the various gases to be expected from volcanoes or rocks: "H_2O, CO_2, CO, CH_4, etc., H_2N_2, A, etc., NH_3(?), S_2, SO_2, SO_3, COS, H_2S, CI_2, F_2, HF, H_2SiF_6, SiF_4." He then remarks that "the list is worth a *few moments' reflection* from the chemist's point of view. There are few gases which are not attacked by any reagent which might be applied to remove some particular one." The gas analyst will recognize many of his old friends in this impressive roll call of volcanic gases. And if some of the members fail to attend the convention of The Troublesome Tribe of Fuel Gases, their not regrettable absence is somewhat offset by the presence of a few malicious newcomers, such as C_2H_6, C_3H_8, C_4H_{10}, C_2H_4, C_3H_6, C_4H_8, C_6H_6, C_7H_8, etc., etc.,—a closely organized brotherhood that defies easy separation.

Confronted with such a set of unaccommodating mixtures, the gas analyst has an excellent excuse. And yet he is hesitant to use it, because he himself, for the most part, has not taken the trouble to find out just how unsatisfactory his reagents and methods of combustion really are. A critical study of methods of gas analysis is still needed.

The present paper will discuss briefly only the first and second factors listed as contributing to unsatisfactory gas analysis. These are (1) faulty design of apparatus and (2) incorrect analytical procedure.

Part I of the paper consists of a brief survey of the more common faults of apparatus design and the analytical errors resulting from them, together with errors which the chemist himself may introduce. Part II of the paper is devoted to the description of an improved apparatus, together with a brief summary of the procedure for its use. A typical analysis of a fuel is given as an illustration. This section may be used as a condensed laboratory manual for the operation of the improved apparatus.

Part I. Common Faults of Apparatus Design and Incorrect Analytical Procedures

1. The Measurement of Gas Volumes

The ordinary volumetric gas analysis is performed with a Hempel burette and separate pipettes, or with an apparatus which has a series of pipettes connected to a burette. The latter type of apparatus is commonly called an "Orsat." It has been aptly described as a "push-pull" apparatus, since the gas is "pushed" from the burette to a pipette where reaction occurs, and then "pulled" back into the burette for measurement. It is the only apparatus discussed in this paper, since lack of space forbids detailed mention of the more antiquated types, which may properly be dismissed from serious consideration. If such dismissal appears abrupt, it is nevertheless as justifiable as the elimination of the kerosine lamp where the electric light is available.

[1] *The Analysis of Gases Obtained from Volcanoes and from Rocks, Jour. Geology, 33, No. 3, Supplement April-May (1925). Also paper from the Geophysical Laboratory, Carnegie Institution of Washington, No. 564.*

Publication approved by the Director of the Bureau of Standards, Department of Commerce, Washington, D. C.

It is, of course, understood that a volume of the gas mixture must be measured, and that each constituent must be removed and the contraction in volume resulting from its removal determined. The comparison of these diminishing volumes with that of the original sample affords the basis for determining the percentage of the components. It is therefore necessary that each volume measured be corrected to the same temperature and pressure. This is automatically accomplished by use of a manometer-compensator unit. The compensator itself is a tube of the same size as the burette and placed parallel to it. Both are surrounded with water. The temperature of one closely approximates the temperature of the other. The quantity of gas in the compensator is fixed at the beginning of an analysis and the pressure at which the gas is measured in the burette is always adjusted to the compensator pressure by means of an interposed manometer which indicates when this pressure has been attained within the burette. The gas within the burette must be saturated with water before every measurement, and the compensator contains a small amount of water, so that the vapor pressure within one balances the vapor pressure within the other. Assuming correct manipulation and design the series of gas volumes which are to be compared are, therefore, converted to uniform conditions of temperature, pressure, and humidity without calculation.

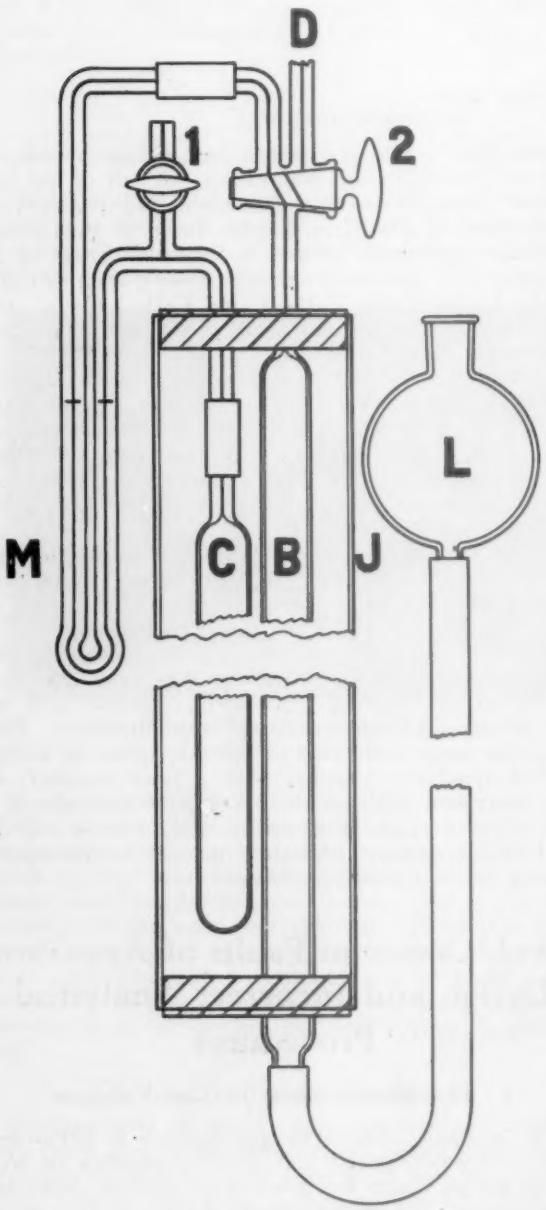


Fig. 1.—Usual Assembly of Burette-Manometer-Compensator.

The burette B is connected through stopcock 2 to the manometer M, which in turn connects to the compensator C. Stopcock 1 connects C to the atmosphere. B and C are mounted in the water filled jacket J. The leveling bulb L supplies confining fluid to B. B. connects to the distributor or manifold, leading to the pipettes, at D.

The analysis can be no more accurate than the measurements of the gas volumes. Once the accuracy of these measurements is known, it is a matter of simple arithmetic to determine the maximum limit of accuracy of the analysis. It will be of interest to examine the usual burette-manometer-compensator assembly from this point of view. This arrangement is sketched in Figure 1. The unit is comparatively fragile and involves awkward manipulation in assembling or dismounting. However, the real objection to it lies in the fact that its use introduces significant errors in the measurement of gas volumes. These may be briefly outlined.

(a) *The burette.*—A common fault of many burettes supplied for gas analysis lies in the fact that the graduations are extended less than one-half way round the circumference. Because this system of graduation does not permit the elimination of parallax, serious errors are usually introduced in reading the volumes. Such errors may easily amount to 0.1 mm. If an error of this magnitude occurs during a combustion analysis, it may appear as several tenths of a per cent in the computed results.

Burettes should not be graduated to 0.1 mm. Because of practical considerations, the length of the graduated portion of the usual 100 mm. burette is between 60 and 70 cm. If this is subdivided into 0.1 mm. portions the graduations are less than 1 mm. apart, and tests have shown that accuracy is lost under these conditions.

A second source of error arises from the lack of a positive means of interrupting the mercury[2] flow between the burette and leveling bulb. There is consequently no assurance that the mercury within the burette will remain at the proper level for the volume reading after the pressure has been balanced. It is difficult to assign a definite order of magnitude of errors caused in this way, since they depend upon the technique used. If the leveling bulb is held in the hand while the pressure is balanced and the volume read, very serious errors will occur. If the bulb is moved by a gear system, or the mercury is moved by mechanical displacement from the bulb, the errors will be smaller. Such errors can be eliminated only by placing a stopcock at the bottom exit of the burette.

Another error is often introduced by faulty arrangement of the stopcocks connected at the top of the burette. This system of cocks may not permit the in-

[2] *It is assumed that mercury is used as the confining fluid. Water or a water solution of some salt introduces errors of absorption so great that their use is impossible for careful gas analysis.*

troduction of a gas sample without contamination with air contained in the connecting capillaries.

(b) *Manometer.*—The manometer usually employed introduces three distinct errors. One is attributable to the fact that in making the pressure balance it is impossible to avoid transferring a reactive portion of the gas sample to the arm of the manometer connected to the burette, and equally impossible to return this portion to the burette (where it may again engage in its proper part of the analysis), without frequently siphoning the mercury from the manometer. Thus, at different stages of the analysis, various portions of the gas do not reach the pipettes in which they are intended to react. The result is a series of reactions which are incomplete by undetermined amounts. The error may be particularly large when the total contraction after combustion is measured, and the carbon dioxide produced is then determined.

The bore of the manometer is usually small, measuring between 1 and 2 mm. This is a somewhat glaring fault, since the capillary errors involved are sufficient to cause errors of several tenths of a per cent in the measurement of gas volumes, even though both arms of the manometer are made "from the same tubing" (which, as a matter of fact, is of secondary importance). The meniscii are never equally clean, nor of *equal height.* In order to reduce this type of error to an insignificant amount, 8 to 13 mm. inside diameter reading is necessary[1].

The third error involved is the adjustment of the mercury in the manometer to the fixed reference. Etched lines upon the glass are commonly used, although a point placed outside the manometer is sometimes employed. Neither method is sufficiently accurate to avoid errors which may be significant.

(c) *Incorrect procedures.*—In addition to errors imposed by poor design of the apparatus, the analyst, and particularly the tyro, is apt to commit errors of technique. The common mistakes may be outlined.

Errors of several per cent may occur if the gas within the burette is not saturated with water vapor. This is ordinarily obtained from a film of water on the burette wall, and the presence of this water must be assured throughout the analysis. Several of the reagents employed remove most of the water vapor from the gas, and it does not again reach saturation within the burette unless the entire surface exposed is moist. Even then two minutes should be allowed for saturation. If the upper portion of the burette is dry and the lower portion moist, saturation occurs very slowly, sometimes requiring 20 to 30 minutes standing.

Another common error occurs when the burette is only partly filled with gas. The temperature of the gas confined at the top of the burette may not be the same as the temperature of the gas in the compensator, unless the temperature of the water path is kept uniform throughout, and, in the case of a gas just burned, the products of combustion are allowed to cool to the proper equilibrium temperature. It is obvious that temperature differences may exist in an unstirred water bath of the length and diameter ordinarily employed for this work.

Another cause of error is improper illumination of the meniscus. Experimental study has shown that a satisfactory illumination consists of a uniform diffused lighting placed back of the burette with a shield interposed between the burette and the source of light. The shield throws a shadow upon the mercury so that the ordinary mirror surface is transformed into a sharply defined curved black line.

It may be thought unnecessary to point out that the apparatus must be free from leaks. Nevertheless, the point must be emphasized, since this source of error is often present when least suspected. Rubber connections are a prolific source of leaks. A good grade of rubber tubing must be used and should be replaced often enough to insure its good condition. A rubber connection is best secured with a number of turns of waxed dental floss. A very large leak lends itself to early discovery, but a small leak may be insidious, appearing and disappearing in the final results in the most perverse ways and driving the analyst into a state of complete distraction. For this reason, the apparatus should be tested frequently under both pressure and vacuum.

2. Transfer of Gases

(a) *Gas-filled and liquid-filled distributors.*—The burette is connected to the various pipettes with a capillary manifold or train, which may be called by the descriptive term "distributor." In practice, the distributor may be filled with an inert gas or with a confining liquid. The latter type possesses the advantage of decreasing or eliminating dead capillary space. If the distributor, including the vertical connections to pipettes, is entirely filled with confining liquid, the apparatus becomes somewhat complicated, and is seldom used. The distributor partially filled with confining liquid has recently come into use. Considerable experience with both gas and liquid-filled distributors has shown that the liquid-filled type is more difficult to operate, and it will occasionally trap significant amounts of gas. The gas-filled distributor appears to be the better suited for this general kind of gas analysis apparatus. Its only disadvantage, that of dead capillary space, can be overcome in one of two ways, which are discussed later.

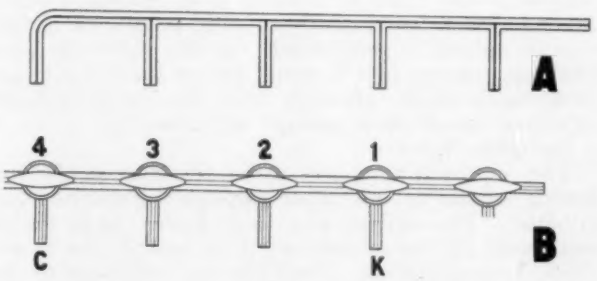


Fig. 2.—Usual Types of Distributors.

(b) *Usual types of distributors.*—There are two common designs which are sketched in figure 2. The only difference is that distributor B, equipped with tee cocks, is subject to traffic control and the distributor A is not. Since the gas can be transferred within a definite fixed path in B, it not only eliminates the extra dead capillary space always present in A, but makes possible a correction for the dead capillary space it itself does not eliminate.

(c) *Incorrect procedures.*—There are four mistakes which are often made in the use of the gas filled distributor. The first is failure to fill the distributor with an inert gas which itself does not take part in the reactions involved. The second is failure to adjust the distributor to the compensator pressure before determin-

[1] *Weight Buret for Gas Analysis, E. R. Weaver and P. G. Ledig. J. Am. Chem. Soc., 42, 1177 (1920).*

ing a gas volume. The third is accidental fouling of the distributor with a reagent from some pipette, and subsequent failure to realize that reactions are taking place within the distributor where they have no business to occur. These are obvious mistakes, but, unfortunately, they are frequently made.

The fourth mistake may be illustrated by a definite example. Suppose carbon monoxide is burned with oxygen in a combustion pipette connected at C (Fig. 2) and after the contraction upon burning is measured, the carbon dioxide produced by the combustion is determined by absorption in the pipette connected at K. The volume of the capillary space of the horizontal portion between cocks 1 and 4, plus the volume in the vertical connection to C, may be assumed from average observations to be 0.7 ml. We shall take a sample of 80 ml. of carbon monoxide, burn it with 50 ml. oxygen, and thus obtain 80 ml. of carbon dioxide + 10 ml. of oxygen after burning. The total contraction is thus $(80 + 50) - (80 + 10) = 40$ ml., from which carbon monoxide = 100%.

At this point a very usual technique is to pass the carbon dioxide + oxygen into K, absorb the carbon dioxide, and determine the contraction. In so doing, carbon dioxide is left in the distributor to the left of cock 1. The amount is calculable. The total volume of gas which was not passed into K is 0.7 ml. The proportion of carbon dioxide in this gas is $\frac{80}{90}$. The amount of carbon dioxide which is not absorbed in K is therefore $\frac{80}{90} - 0.7 = 0.62$ ml. The carbon dioxide observed after combustion is therefore 80.00 — 0.62 = 79.38 ml. The percentage of carbon monoxide computed from this is 99.2. The error is 0.8%, and since it may be avoided it should not be tolerated. The obvious correction is to pass the gas into C after the first removal of carbon dioxide, and so regain the carbon dioxide in the train by dilution with residual oxygen, after which it can be absorbed in K before the carbon dioxide volume is determined. In this particular case, one such passage into C would reduce the error to approximately 0.1%, although with the usual fuel gas mixtures one dilution passage will lower the error to a negligible figure.

The improved apparatus to be described in the following section of this paper employs a calibrated distributor. The analyst may then depend upon simple arithmetic for his corrections, if he prefers this to additional manipulation. Thus the one objection to the gas filled distributor is overcome.

3. Absorption and Combustion

(a) *Absorption pipettes.*—There are only two errors connected with the design of the many types of absorption pipettes available. One is the likelihood of trapping gas with a packed filling designed to provide contact surface, or at the dome of the pipette. This may be overcome with reasonably careful construction. The second is a tendency observed with some pipettes to carry drops of reagent into the distributor when the gas is returned to the burette.

The serious errors of absorption analysis are mainly attributable to the reagents used. Some of the difficulties encountered in this field have been investigated, but the whole subject needs further study.

(b) *Combustion pipettes.*—The combustion pipette in common use at the present time, known as the Dennis and Hopkins pipette, is very apt to introduce errors as the result of leakage. Weaver and Ledig[4] have pointed out its disadvantages. Leakage is apt to occur as follows: "It is difficult to make the stopper at the bottom of the pipette and the connections through it perfectly tight. The leakage of mercury is easily detected, but the pipette may be tight to mercury and allow air to leak in when its contents are under reduced pressure, and such a leak is likely to be overlooked for a long time.

"In order to insulate the leads it is necessary to inclose one or both of them in glass tubes. The platinum wire is usually sealed through these tubes and the connection with the lead made inside the glass tube. This is a rather difficult form of construction and one hard to repair. The point at which the wire is sealed through the insulating tube is the most likely to crack in the whole apparatus, and such cracking is likely to cause an undetected leak. If the leads pass through the glass and the active wire is crimped on, as is sometimes done, the junction usually has the highest resistance of any part of the circuit and is the first to fail in use. A solder can not, of course, be used in the presence of mercury. As the apparatus is frequently constructed, sufficient relative motion between the leads to distort or even break the platinum wire is possible. (It may be added that in case the platinum wire is supported on a ceramic body, uneven heating is apt to result and only a portion of the wire may be sufficiently heated to cause combustion to take place. Also, gas may be trapped or absorbed by the ceramic support.)"

(c) *Incorrect procedures.*—Some of the common mistakes made during the absorption and the combustion have already been indicated. In addition to these, attention should be called to the fact that the combusion may be incomplete, especially if heavy hydrocarbons are present. After the removal of carbon dioxide, the completeness of combustion may be checked to advantage by passing the residual gases back to the combustion pipette. The gases should be burned in an excess of oxygen. The oxygen is put into the pipette first, and the combustible gas is then passed slowly over the hot spiral. These details of procedure are not always followed. The combustion should be slow and quiet, never explosive. Combustion over copper oxide has been recommended by some investigators, and may be used at the discretion of the analyst.

In conclusion, it is well to point out that nitrogen is usually determined "by difference." This procedure possesses the sometimes distinct advantage of insuring an analysis which almost inescapably totals an even 100%[5]. While this may be gratifying to report, the procedure cannot be considered entirely elegant. It seems worth while, even at the risk of occasional embarrassment, to settle the matter somewhat more definitely by absorbing the excess oxygen after combustion and measuring the residual nitrogen. In this manner the analyst will be able to determine whether he has some out of the same hole into which he crawled some time previously.

(Continued in May Issue)

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[4] *E. R. Weaver and P. G. Ledig, Ind. Eng. Chem., 12, 368; 1920.*

[5] *This statement may be open to criticism. In fact, we recently saw the data for an analysis of "mixed" fuel gas whose constituents totaled over 110% before the analyst had a chance to compute N_2 by difference. And this uncomfortably large figure was obtained after subtracting an observed minus percentage of ethane.*

Stoichiometry Of The Blow

LLOYD LOGAN

THE reactions during the blow may be represented stoichiometrically as follows:

$$C + O_2 + 3.76\,N_2 = CO_2 + 3.76\,N_2 + 174{,}600 \text{ B.t.u.} \quad (2a)$$
$$2C + O_2 + 3.76\,N_2 = 2CO + 3.76\,N_2 + 104{,}400 \text{ B.t.u.} \quad (1)$$

Assuming that only these reactions occur during the blow, an examination of the equations will indicate (1) that the mols ($CO + CO_2$) in the blast gas will be equal to the mols of carbon consumed, regardless of the mode of oxidation; (2) that the volume of CO_2 equals that of the O_2 consumed in its production; (3) that the volume of CO equals twice that of the O_2 entering into its production; (4) that there is a unique relation between the CO, CO_2, and N_2 contents of the blast gas, the composition varying according to the mode of oxidation from 21 percent CO_2, 0.0 percent CO, and 79.0 percent N_2 for complete combustion, to 0.0 percent CO_2, 34.7 percent CO, and 65.3 percent N_2, for combustion only to CO, and (5) that from the determination of any one of the three components on the blast gas, the amounts of the other components may be at once known. This is shown in Table 1, from which are plotted the accompanying trilinear diagram, Fig. 1, and the curves (Fig. 2) showing the relations of the amount of carbon consumed per mol of O_2 and the relation of the blast gas-generator air ratio on the CO_2 content.

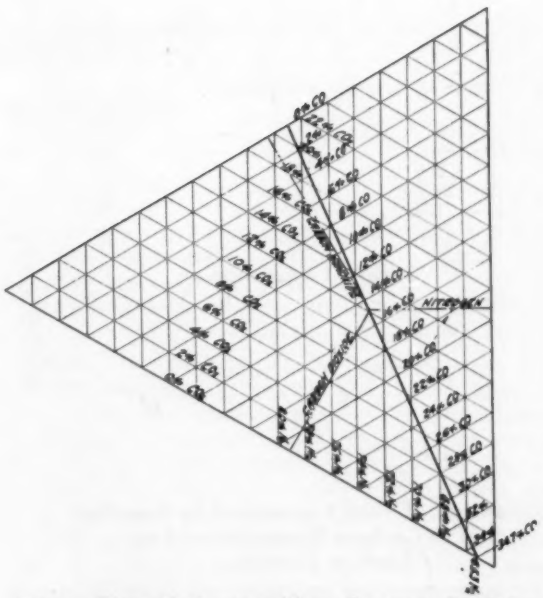


Fig. 1—Theoretical composition—Generator Blast Gas

An analysis of the stoichiometry of the blow, detailed more fully in the appendix, indicates that if the generator air and the percentage of CO_2 in the blast gas are known, the amount of carbon consumed during the blow, as well as the volume of blast gas, are fixed, providing no uncombined oxygen passes through the fire. The following nomenclature will be used:

a = mols CO in blast gas
b = mols CO_2 in blast gas
c = mols C consumed during blast
g = mols blast gas produced
o = mols O_2 consumed
n = mols N_2 associated with o = 3.76o
r = mols air (molecular weight = 29.0) = 4.76o

$\frac{b}{g} \times 100$ = percentage of CO_2 in blast gas.

TABLE I

Percentage of Oxygen converted by		Volume of Blast Products in Mols					Percent in Blast Gas			Carbon Consumed during Blast			
Reaction $C + O_2 = CO_2$	Reaction $2C + O_2 = 2CO$	CO_2	CO	N_2	Total	$CO + CO_2$	CO_2	CO	N_2	Ratio of Volume of blast gas/volume of generator air	Mols per 100 mols Oxygen	Lbs. per mol of oxygen	Lbs. per M cu. ft. of generator air
100	0	100	0	376	476	100	21.0	0	79.0	1.0	100	12.0	6.65
90	10	90	20	376	486	110	18.5	4.1	77.5	1.021	110	13.2	7.31
80	20	80	40	376	496	120	16.1	8.1	75.8	1.042	120	14.4	7.98
70	30	70	60	376	506	130	13.8	11.8	74.4	1.063	130	15.6	8.64
60	40	60	80	376	516	140	11.6	15.4	73.0	1.084	140	16.8	9.31
50	50	50	100	376	526	150	9.5	19.0	71.5	1.105	150	18.0	9.97
40	60	40	120	376	536	160	7.5	22.4	70.1	1.127	160	19.2	10.64
30	70	30	140	376	546	170	5.5	25.7	68.8	1.148	170	20.4	11.31
20	80	20	160	376	556	180	3.6	28.8	67.6	1.169	180	21.6	11.97
10	90	10	180	376	566	190	1.8	31.9	66.3	1.190	190	22.8	12.63
0	100	0	200	376	576	200	0	34.7	65.3	1.21	200	24.0	13.30

Abstract of a dissertation, "An Investigation of the Manufacture of Water Gas with Especial Reference to the Decomposition of Steam", presented at Johns Hopkins University for Degree of Doctor of Engineering.

$\frac{b}{g} \times 100$ = percentage of CO_2 in blast gas

From the reactions

$$C + O_2 + 3.76\,N_2 = CO_2 + 3.76\,N_2 \quad (2a)$$

$$\text{and } C + \frac{1}{2} O_2 + 1.88\, N_2 = CO + 1.88\, N_2 \qquad (1b)$$

the following relations follow:

$$o = b + \frac{a}{2} \qquad (5)$$

$$a = 2o - 2b \qquad (6)$$

$$c = a + b = 2o - b \qquad (7)$$

$$g = a + b + n \qquad (8)$$

Carbon Consumption

From these relations may be derived the carbon consumption, c, thus:

$$c = \frac{\frac{r}{2.38}\left(1 - 1.88\,\frac{b}{g}\right)}{1 + \frac{b}{g}} \qquad (9)$$

Segregation of Fuel Consumed by Combustion to Carbon Monoxide and to Carbon Dioxide

To understand the course of the reactions occurring in the blow, it is desirable to segregate the carbon consumed by combustion to CO and that consumed by combustion to CO_2. These relations are:

$$\text{Mols carbon consumed by combustion to CO} = r\,\frac{\left(\frac{1}{2.38} - 2\,\frac{b}{g}\right)}{1 + \frac{b}{g}} \qquad (10)$$

$$\text{Mols carbon consumed by combustion to } CO_2 = 1.21r\,\frac{\frac{b}{g}}{1 + \frac{b}{g}} \qquad (11)$$

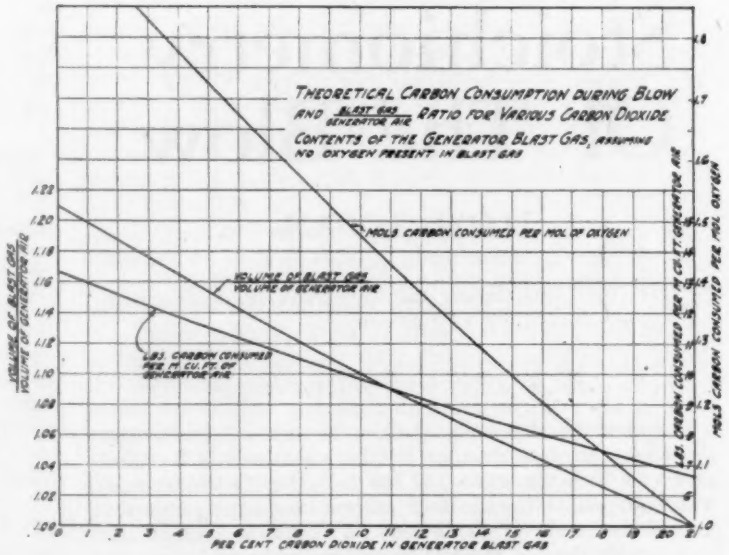

THEORETICAL CARBON CONSUMPTION DURING BLOW AND BLAST GAS / GENERATOR AIR RATIO FOR VARIOUS CARBON DIOXIDE CONTENTS OF THE GENERATOR BLAST GAS, ASSUMING NO OXYGEN PRESENT IN BLAST GAS
MOLS CARBON CONSUMED PER MOL OF OXYGEN
VOLUME OF BLAST GAS / VOLUME OF GENERATOR AIR
LBS. CARBON CONSUMED PER CU. FT. OF GENERATOR AIR
VOLUME OF BLAST GAS / VOLUME OF GENERATOR AIR
LBS. CARBON CONSUMED PER CU. FT. OF GENERATOR AIR
MOLS CARBON CONSUMED PER MOL OXYGEN
PER CENT CARBON DIOXIDE IN GENERATOR BLAST GAS

Figure 2

Volume of Blast Gas

The volume of blast gas may likewise be calculated by the formula

$$g = \frac{1.21r}{1 + \frac{b}{g}} = \text{mols blast gas} \qquad (12)$$

Composition of the Blast Gas

If one component of the blast gas be known, the other two components may be readily calculated, e. g.—

$$\text{Per cent CO} = 100 \times \frac{a}{g} = \frac{100 - 4.76\,\left(\frac{-}{g} \times 100\right)}{2.88} \qquad (13)$$

Making Utility Stocks into Ideal Investments

Although the following remarks were addressed to those interested in the electric utilities, they seem with slight paraphrase equally applicable to the gas industry. Mr. Matthew S. Sloan, President of the New York-Edison System, has in the quoted portion of his recent address before a chapter of the American Institute of Bankers, set down a group of ideals toward which any gas-utility management may well strive. Few will claim that their companies have already reached such an ideal.—Editor.

WHEN a banker considers public utility securities for investment or for recommendation to his depositors, or as a possible participant in an underwriting syndicate, he deals with one company. He analyzes that thoroughly in respect of its financial condition, its policies, the ability shown by its management, its relation with its customers and the public generally. Discussing, not one company, but utilities generally along those lines we may see why utilities—that is, good utilities—are good investments. Of course we know that they are not all of a piece. Some are good; others, in one respect or another, may not be so good, which is to say that my business, like any other, is subject to the infirmities and errors which attend all human endeavor.

Securities of good utilities are desirable investments because:

1—It is an unusually stable business.

2—It is a growing business; growing with population increase; growing with the higher living standards which American ambition always produces; growing with the result of wide and intensive scientific research.

3—It is a business which makes its product on customers' demands; hence has no problem of surplus goods.

4—It is a business as free from labor troubles as one can be.

5—It is a virile, progressive business, willing and able to avail itself of the efficiencies, economies and new sales possibilities which technical study and experimentation and research make possible.

6—It is a business kept on its toes by the fact that it serves every class and group in our population, in home and place of business. Supplying a necessity of life, it is under the keenest critical observation every minute of the twenty-four hours. If that statement seems a bit broad, I refer you to the daily mail of any utility executive.

7—It is a business supervised and regulated by public authority. As such, its rates, its quality of service, its capital issues are under official scrutiny, and it operates with the legal guarantee of a fair return on the value of its investment in property used for public service, if it can earn it. That qualification means much, but at least the utility has legal protection against rates which might be set so low as not to yield a fair return under proper management.

The Direct Steam Radiator

Some Data and Observations of Vital Interest to the Gas Househeating Man

W. E. STARK

Research Engineer, The Bryant Heater & Mfg. Company.

IN all of the intensive research that has contributed to the development of the art of heating and ventilation during the past decade, there is no more interesting or productive portion than that having to do with the time-honored cast-iron direct radiator. Although the non-ferrus extended-surface type of concealed radiator has supplanted, to an extent, the cast-iron radiator in homes of the better class and in some recent office buildings, still it cannot be said that the cast-iron radiator is by any means an antique. Manufacturers of cast-iron radiation reported during 1930, sales of 85 million square feet, and although this amount represents a decrease as compared with the preceeding year, it is not a materially greater decrease than that prevailing in the heating industry in general. The cast-iron radiator is far from obsolete.

The primary task of the radiator is to maintain a condition of comfort in the room within which it is installed. Its secondary function is to maintain that condition with the expenditure of as little steam as possible. It is only within the last few years that there has been a realization that this secondary function existed; that it was possible for one radiator to maintain a given degree of comfort, or a given breathing line temperature; with the expenditure of less steam than that of another type of radiator. The steam condensing capacity of a radiator has been generally looked upon as directly proportional to its comfort producing capacity, a belief that recent developments have demonstrated to be untrue. It has been shown that a pound of steam condensed in one radiator may go farther in the production of really useful heat than a pound of steam condensed in a radiator of another type. This property, if taken advantage of, reflects itself in a lowered radiation and boiler requirement, or lessened fuel bill; and, incidentally, in the maintenance of a rather more pleasant condition.

What Research Has Shown

Research has developed the fact that certain types of radiators; or certain types of radiator covers or enclosures, applied to the ordinary direct column radiator; will produce the same air temperature at a point, for example 2 feet, 6 inches above the floor as that produced by another type, but with a considerably lower temperature just below ceiling level. With a lower ceiling temperature there is a lower rate of heat loss through the ceiling and through the upper portions of the side walls, and hence, a lowered rate of steam condensation in the radiator. It follows then that the rate of steam condensation as determined by a test of a radiator, is not necessarily a measure of that radiator's true usefulness as an instrument of heating. Some engineers have suggested that direct radiators should be rated on a basis of effective warming, rather than on the usual basis of total condensation or total heat emission. It is difficult to conceive, however, how this could be accomplished satisfactorily.

The performance of a radiator can be measured according to either of two standards. "Heat emission," as found by condensation and expressed in B.t.u. or pounds of steam, represents the capacity of a radiator as a condenser, under stated working conditions. It is a quantity dependent on the shape, arrangement, and proportions of the radiator surface. "Heating effect," on the other hand, is a quality rather than a quantity. Some kinds of radiator surfaces radiate a relatively large proportion of their heat emission, and this radiated heat travels in a horizontal direction, normal to the surface of the radiator, thus warming the lower levels of the room. Other types of surfaces emit their heat by convection to a greater degree than by radiation, thus imparting their heat to the heated space by warm air currents rising vertically. The degree of comfort produced by a radiator is affected to as great a degree by the quality of the heat, or the direction of its projection, as it is by the quantity of heat. So far as the ultimate user is concerned, the quality of the heat is of paramount importance. He is interested not in pounds of condensation, but in comfort. It is primarily the task of the heating engineer to give the user the desired quality and quantity of heat where the user wants it; and secondarily, to give him that heat with the expenditure of as few pounds of condensation as possible.

Effect of Radiator Height

As illustrative of the seeming lack of relation between pounds of condensation and the actual heating effect of radiators, tests reported by Brabée[1] are of interest.

Two radiators, one of them a 3 column 38-inch Peerless type radiator with a heating surface of 67.5 square feet, and the other 12 inches high with a heating surface of 33.4 square feet, were placed in identically sized rooms having equal exposure. The second radiator was one having a large proportion of its surface direct radiating surface, exposed to the view of the room being heated. In a subsequent test the 38-inch Peerless radiator was replaced by one 19-½ inches high having a heating surface of 34.8 square feet. Table I below shows the essential results of the first test, comparing the 38 inch and 12 inch radiators.

Table I

Radiator Type	Surface (sq. ft.)	Temperatures* at knee	at ceiling	Difference floor to ceiling	Condensation rate
3 col.—38″	67.5	74.7°	88.8°	14.1°	16.3 lbs.
12″	33.4	76.0	75.2	—0.8	7.9 / hr.

Table II shows the essential results of the second test, comparing the 12 inch and the 19-½ inch radiators.

Radiator Type	Surface (sq. ft.)	Temperatures* at knee	at ceiling	Difference floor to ceiling	Condensation rate

Table II

12″	33.4	70.0°	72.2°	2.2°	7.26 lbs./hr.
19½	34.8	67.5	80.9	13.4	8.23

*After four hours of operation, starting at about 62 degrees.

[1] C. W. Brabee—Transactions of the American Society of Heating and Ventilating Engineers, Vol. 23, 1927.

The results of these tests demonstrate the ability of a low radiator to heat *by radiation* the region close to the floor; as compared with the tendency of a higher radiator to *overheat by convection* the region near the ceiling, at the same time that it is heating the region close to the floor to a temperature equivalent to that produced by the low radiator. The knee high temperatures were measured by mercury theromometers exposed to radiant heat from the radiators, just as the human body is similarly exposed to the radiators in living quarters.

The condensation rates are directly related to fuel consumptions. It should be borne in mind, however, that these comparative condensation rates would establish differences to a greater degree than ratios. In more severe weather the respective condensation rates would probably increase in proportion to the inside-outside temperature difference; that is, the condensation rate of the low radiator would increase in a greater ratio than that of the high radiator.

Experiments reported by Willard and Fahnestock[2] furnish added confirmation to the conclusion that the amount of condensation is not a true measure of a radiator's performance, and that two different types of radiators can heat a room to the same degree of comfort but with quite different heat losses and consequently with quite different expenditures of steam. In their experiments two practically identical rooms were heated respectively with a 27 square foot long, narrow wall radiator placed under a window; and with a 36 square foot 2-column 38-inch radiator placed beside a window. The comparative performance of the two radiators is expressed by the following table.

Table III

Radiator Type	Outdoor	Temperatures Floor	30" above floor	60" above floor	Ceiling	Differences floor to ceiling	Differences 30" above floor to ceiling
Wall	8.3	69.6	69.9	69.4	71.1	1.5	1.2
"	—10.0	66.6	66.0	66.8	68.0	1.4	2.0
38"-2 col.	7.8	67.6	71.9	78.5	86.5	18.9	14.6
	— 9.5	61.4	66.2	73.0	79.9	18.5	13.7

In studying these figures, the significance of the various levels at which temperatures were observed should be kept in mind. At the floor, or rather 3 inches above the floor, where the readings were actually made, is "ankle height." In these days of sheer hosiery and low-cut shoes the year round ankle temperature has a decided bearing on bodily comfort; for at that point the blood stream is very close to the surface and is easily chilled. The temperature at a point 30 inches above the floor is also important to bodily comfort, for our resting hours are spent with practically our entire bodies at or below that level. To persons sitting at rest the so-called "breathing line" temperature is of no importance whatsoever. In short, what is needed for comfort is an equable temperature from breathing line down to floor; and for economy, the lowest temperature that can be maintained, from breathing line up to ceiling.

Notice that the wall radiator maintained a practically constant temperature from breathing line down to floor level, as well as substantially the same temperature from breathing line up to ceiling. The 2 column-38 inch radiator on the other hand, while maintaining a substantially satisfactory temperature at floor level and 30 inches above the floor (on a moderately cold day) actually over-heated the room at the breathing line and seriously over-heated it at the ceiling line. It would therefore condense more steam than did the wall radiator, for the higher inside temperatures meant greater heat loss, which could be made up only by increased steam condensation.

Notice further, that the room heated by the wall radiator exhibited less tendency toward stratification on an extremely cold day than did the room heated by the 2-column-38 inch radiator, in that the floor to breathing line differential in the wall radiator heated room actually decreased as the weather became colder, while in the other room this differential increased. The wall radiator led to the effect of low outdoor temperature, being felt less keenly indoors than did the 38-inch radiator.

The brief conclusions to be drawn are:

(a) Long low radiators placed under windows produce a greater degree of comfort than do taller radiators placed beside windows.

(b) Long low radiators heat more economically (less steam and fuel) than do taller radiators.

(c) In a room heated with a long low radiator, extremely cold weather leads to less stratification than in a room heated with a tall radiator.

It is evident that the season's heating bill is affected by the type of radiation used, and that two houses identical except for radiation may be heated to equal degrees of comfort at decidedly different costs.

Effect of Finish

It has been shown that so small a thing as the color of a coat of paint may have an effect on the amount of heat that a radiator emits. Severns[3] reports that following values of the coefficient of heat transmission, (k) expressed in B.t.u. per square foot per degree difference per hour, for a single type and size of radiator, painted with various finishes.

Finish	(K)	Relative Value of (K)
One coat dull black Pecora paint	1.76	100.0
Gray paint dipped	1.78	101.1
One coat aluminum bronze	1.60	90.8
Bare iron, foundry finish	1.77	100.5

The above values pertain to three-column radiators.

Since the effect of the finish is limited to that component of the total heat emission which is given off by radiation, it follows that the finish would have a greater effect on a radiator which gave off a larger proportion of its total heat emission by radiation, such as a wall radiator. It has further been shown by other investigators that it is the final coat of finish which determines the heat emission of a radiator. Thus, a radiator initially painted gray, with a relative value for the coefficient of 101.1, would have this relative value reduced to 90.8 by the application of a coat of aluminum bronze over the gray paint.

Effect of Enclosures

The use of enclosures, or "radiator furniture," as a means of improving the appearance of a direct cast-iron radiator, is becoming quite common. Such enclosures all have an effect on the steam condensed; and therefore on the heat emitted; the effect varying in degree with the design of the enclosure. They may also be reflected in the "heating effect" of the radiator. In general, the enclosure reduces the amount of steam condensed by the radiator. This apparent reduction in the capacity of the radiator may, however, be more than offset by the improved heating effect, for the reduction in condensation caused by a properly designed enclosure reflects itself in the maintenance of a higher average tem-

[2] A. C. Willard and M. K. Fahnestock—Heating, Piping and Air Conditioning, March, 1930.

[3] Wm. H. Severns—Transactions of the American Society of Heating and Ventilating Engineers, Vol. 33, 1927.

perature from floor to breathing line, and a lower average temperature from breathing line to ceiling. Application of a properly designed enclosure may leave unchanged the breathing line temperature, reduce the temperatures above the breathing line, and increase the temperatures below the breathing line. If at the same time it produces this effect, it reduces the condensation rate —it has produced better heating at less cost. For proper performance the area of the enclosure outlet should not be less than the free area through the radiator, and the area at the enclosure inlet should not be less than 80 per cent of the outlet area.

Rating of Radiators

Until a few years ago the direct cast-iron radiator was rated in square feet of surface, the square foot of such a radiator surface having an average heat transmitting value of 240 B.t.u. per hour. The surface area was a fairly accurate index of the heating capacity of the old familiar column radiator. However, the newer tubular type radiators (the column radiator has not been made since 1926) introduce a different problem. Their characteristics are such that a square foot of their surface has a much different heat transmitting value than a square foot of column radiator surface. Manufacturers are therefore rating them either in hourly B.t.u. transmitting capacity, or in equivalent square feet of 240 B.t.u. per hour, or in both manners; and as has already been brought out, there is a well defined school of thought which believes that there should be an additional scale of radiator performance, comfort producing effect.

Natural Gas Heats Historic Structure

THE old Customs House at Monterey, California's governmental headquarters under the flags of Spain and Mexico and under the United States for a time after Commodore John Drake Sloat hoisted the Stars and Stripes there in 1846, is warm and cozy this winter for the first time since it was erected in 1814. A natural gas heating system has banished chill from the historic stone and adobe structure, where fireplaces and sundry types of stoves failed for more than a century to keep the cold away.

Pablo de Sola, Spanish governor, thought when he built the place that huge fireplaces would solve the heating problem. But they warmed up only a few square feet directly in front of them and charcoal burners were a familiar sight at all special occasions, such as the grand balls to celebrate the arrival of galleons from Spain or the Philippines. Even with them the rooms were chilly, which probably accounts for the popularity of Spanish shawls in those days.

The Mexicans left things pretty much as they were when they took over California and the Customs House in 1821, so fireplaces and charcoal burners continued to smoke up the ceilings with the help of crude oil lamps and tallow candles.

The Americans depended on fireplaces at first and even installed more of them when they completed the north wing, which the Mexicans had started, and built the south wing to match it. Stoves were introduced however, before the capital was moved north in 1849 and newer models appeared from time to time until 1867, when the customs service deserted the post for San Francisco. Still the place was never completely warm.

Apparently forgotten for more than 30 years, the Customs House was reconstructed by the State in 1900, at the urge of the Native Sons, who maintained it for a quarter of a century or so—but couldn't keep it comfortable. Then on July 7, 1928, exactly 82 years after Sloat's exploit, the building became a state museum, with Laura Bride Powers as custodian.

Mrs. Powers soon noticed that tourists shunned the place in winter—and she didn't blame them. She just couldn't keep the rooms warm, even with all the fireplaces and several stoves blazing, and her fuel bills were staggering. When natural gas came she installed a gas heating system and solved several problems at once. The fuel bills are lower; the drudgery of stoking fires is over, and it's so easy to keep the whole place comfortable and clean that it is attracting almost as many visitors these winter days as in summer.

—P. G. & Progress.

Gas Refrigerator Sales Mount

A SIXTY per cent increase in sales of automatic gas refrigerators was accomplished during 1930 by the Consolidated Gas Company of New York and affiliated gas companies.

Orders for 32,423 gas refrigerators, or the equivalent of 540 car loads, were received by the company, as compared with orders for 20,273 refrigerators in 1929, and 5,345 in 1928. September, 1930, was a record month for refrigerator sales in the company's history, when orders for 4,601 refrigerators were received.

It is estimated that the refrigerators sold during 1930 will use more than one-half billion cubic feet of gas annually, according to O. H. Fogg, Vice-president in charge of commercial relations.

"The large increase in gas refrigerator sales, achieved in the face of general depression and lessenged building activity, indicates the extent of public demand for automatic refrigeration, which has been accepted as a necessity by the landlord as well as the tenant," Mr. Fogg said.

"The sale of gas refrigerators was in many cases accompanied by the sale of modern gas ranges, indicating a trend to complete modernization of the kitchen with automatic appliances."

The Gas Conversion Burner

N. T. BRANCHE

Engineer, Chg. Househeating Development, Surface Combustion Corp.

(*Continued from March Issue*)

ALL coal fired boilers for domestic heating are limited as mentioned before by the grate area to the amount of coal which they can burn. The circumference of this grate is more than sufficient to accommodate a ring shaped atmospheric burner with the capacity needed to replace the coal consumed at the maximum demand of the particular boiler.

In practice therefore, it has been found that the usual home of six or seven rooms will require a burner of 16" outside diameter, with a maximum capacity of 400 cubic feet of artificial gas. By far the largest percentage of homes and heating plants will require burners of this size. The sales record of a leading manufacturer shows that this type and size of burner is the one which is in average demand. A smaller size 14" in diameter will accommodate practically all the round boilers beneath this rating, and a larger size 20" in diameter is capable of burning up to 600 feet and heating homes up to approximately 15 rooms. From this it may be seen that with three sizes of burners, identical in appearance, construction and operation, we have the ability to convert probably 90% of the homes we encounter. The remaining 10% of the heating plants of the coal fired type encountered are of rectangular shape and are invariably of the sectional type. For these sectional rectangular boilers it has been found that although the grate sizes govern to a large extent, as in the case of the round boilers, the rating of the boiler, that the proportion of indirect heating surface to grate area is greatly increased. Therefore, it is unnecessary to fit the burner heads closely to the rectangular sizes of grates but merely to make conversion burners with suitable baffling which will fit the greatest number of average size rectangular boilers. In this way the rectangular burner may also be reduced to three standard sizes of comparable capacities to the three sizes for the round boilers.

Usual Location of Burner

It is customary on these boilers to install the burner as close to the front of the boiler as possible, allowing whatever extra space there is to remain at the rear in order that the gases after leaving the burner will have as long a travel as possible, for it is the invariable rule with these rectangular constructions to have the flue gases travel to the back of the fire box then to the front through the top passes, then back and out the stack.

It has been thought by many of those who are interested in conversion burners that it is necessary to have the flame or combustion on these rectangular units take place as close to the side walls as possible. The extra proportion of indirect heating surface available in the upper passes of the boiler makes this unnecessary and in reality all that it is essential to obtain is complete combustion in the fire box with as much radiant heat as it is possible to obtain by means of the inclined baffles over the burner flames.

Other Types of Conversions

The operating characteristics of the atmospheric type conversion burner have been described at some length because it represents to date by far the largest majority of burners installed. There are, however, two other types of conversion burners both of which have shown good operating economies and have been standardized upon by some of the gas companies for conversion sales.

One of these classes consists of the type of burners which is equipped with a multitude of small Bunsen tips. These tips are so designed that they will operate at normal pressures with good combustion, primary air being drawn in through the openings at the base of the tubes, and secondary being naturally entrained by the flames at the discharge of the tubes. Such burners of course, depend upon change of demand or consumption in cubic feet per hour on throttling the gas pressure. With this type of burner however, no detrimental effects are obtained by so throttling the burner.

It is noteworthy that these burners control the air supply, both primary and secondary, by means of a door automatically operated in construction with the gas supply valve.

A second class of burner which is coming into prominence is the power burner or the type in which the air is supplied for combustion by means of a low pressure motor driven fan. This type of burner has the advantage in that it is not dependent on gas pressure to entrain the air and may be so adjusted that a large amount of heat is converted to radiant heat. Such a pressure burner may be of either the premixed type whereby a mixture is sent to the burner heads or the non-premix type where the air and gas meet issuing from different ports at the point of combustion. Such burners in appearance closely parallel the oil burners.

Draft Adjustments

It has become almost universal practice on gas equipment to operate it in such a way that the chimney draft will in no way affect the appliance. This is done by means of draft hoods and various other devices which will tend to prevent the suction of the chimney exerting a pull on the appliance to which it is connected. In the case of conversion burners it has been found almost universally that the coal furnaces which are being converted are already equipped with the necessary equipment to break the draft and regulate combustion properly.

The usual manner in which this is done is to get the burner into place, cement it tightly into the ash pit door opening by means of loosely laid brick and a plastic coating of magnesia insulating cement and set the consumption at the required rate per hour to take care of the home in severest weather. After having obtained the amount of gas per hour required and set the primary shutters to give the type of flame which is best described as being all blue with no cone, we find that we have a combustion which is covering nearly the whole height of the radiant baffles.

It is now necessary to adjust the secondary air to

just supply the needs of the burner with a factor of safety of 25% to 35% excess air and this is customarily accomplished by a neutral draft adjustment with a lighted match. The check damper which is the damper opening outward from the flue pipe into the room, is thrown back wide open and wired open. This check damper is of greater area than the cross section area of the flue pipe. Therefore, we have effectively killed any draft suction on the furnace proper, the chimney drawing in the air from the basement. Between this check damper and the furnace is located a butterfly damper. This may be used to regulate the draft of the boiler itself or it may be removed and fire brick cemented in the flue partially closing it until the adjustment is obtained in that manner.

Correct Size of Flue

If the flue pipe were disconnected and the end of it left wide open, the furnace draft itself would be much too great for the proper amount of secondary air. This is one point on which the average gas installation man has often gone astray in conversion work and is the one point which has caused more loss in efficiency than any other. It is remarkable how small an opening is required for the proper discharge of flue gases as compared to the opening required for an equivalent of B.T.U. in coal firing. From practice it has been found that approximately one square inch of flue area for every 10,000 B.T.U. is somewhere near to the required opening.

After opening the secondary air door at the front of the burner and turning the gas on, lighting the burner and allowing it to burn for 5 or 10 minutes until the furnace has become heated up, the flume damper (the butterfly damper) is practically closed. By opening the fire door a mere crack (approximately 1/16 of an inch) and taking a lighted match and running it up and down the vertical side of the door along this crack, it is very easy to determine whether or not there is a suction along the edge of the door or a pressure, the pressure usually immediately blowing the match out due to the lack of oxygen in the flue gases issuing from the crack.

Such a test is extremely accurate for the reason that the flame is very easily affected by a slight draft. The flue damper is now closed down until the top half of the door shows a pressure and the lower half a suction. Thus we have a neutral pressure line midway of the fire door, the pressure being the checking effect of the flue outlet and the suction being the convection effect of the heated gases or chimney effect.

Now, by slightly opening the draft damper to increase the height of the neutral draft line we find the suction is carried to a higher point on the door and the recommended practice which is showing the best results is that the fire door has the neutral line as near the top as it is possible to locate it. After obtaining such an adjustment a check with an orsat will show that it will fall beneath 7% oxygen and above 3% oxygen the usual average being around 5% which is the requirement necessary for most gases to allow between 25% and 35% excess oxygen, a safe condition to run on.

Down Drafts

It is to be noted that with this test laboratory results have shown that a down draft on the chimney with the damper so adjusted will tend to blow out of the check damper opening into the cellar and that the furnace will continue to operate satisfactorily with a reduction of 1% or 2% oxygen. The test which is referred to indicated that a 5% oxygen content in the flue gases would be reduced to 3% with a very severe down draft.

This down draft condition is very rarely encountered in the conversion burner installations for the reason that there are conversions of coal fired equipment which have been operating satisfactorily on solid fuel and in order to operate satisfactorily on solid fuel, must have had considerable draft in order to give any heating results at all. Therefore, save in the cases where a new burner and boiler is installed together in a new home it is usually found that the chimney is in ideal operating shape with very much more draft than is required to carry off the small quantity of flue products which the conversion burner will give.

There are several features regarding the old heating plant which must be considered in the installation of a conversion burner.

Flue and Chimney

It is essential that the flue pipe and the chimney be thoroughly cleaned to remove as much loose soot and carbon deposit as possible, for once that we have our conversion burner running our gas combustion is going to give us a water vapor content in the flue gases and some condensation during the initial starting period in the flue which will tend to dampen and loosen this soot. It is standard practice in one city to provide a cleanout door in the base of the chimney if it is not already installed and instructions are issued in this city to the householder to examine the base of his chimney and clean it out if necessary monthly during the first heating season. This precaution has been found necessary because in that particular locality a grade of coal was used which apparently deposited an excessive amount of soot.

Heating Surfaces

Another feature which is overlooked oft times is the condition of the heating surfaces of the boiler itself. If we have a layer of scale and carbon deposits of a tarry nature over the heating surfaces of the boiler we have in effect a very good insulating coating preventing the rapid transfer of heat between the flue gases of heating section which is desired. It is therefore, essential that these surfaces be cleaned with wire brushes or other suitable methods. Fortunately this cleaning has become a universal practice in many cities by the leading plumbing shops and furnace dealers so that there is a standardized price ranging from $3.00 to $7.00 depending on the locality. In some cases it is even done with a sand blasting outfit to insure extreme cleanliness.

Insulation

In the case of a steam boiler, after cleaning the heating surfaces, it is necessary to insure only that adequate insulation is provided on the boiler and the piping, which should be the case with any properly installed heating plant. If it is not adequately protected it is customary to point out to the owner the defects in his system and explain to him that with proper insulation he will have a far more satisfactory heating plant whether he burns gas or any other fuel.

Warm Air Furnaces

There is also regarding a warm air furnace the necessity of checking up on the sealed joints of the fire bowl and radiator sections. These should be inspected and various methods have been worked out to see that there are no leaks which will dilute the flue gases with excess oxygen and in the upper half of the furnace, perhaps cause their escape into the home.

After the heating plant is in shape the installation of the burner proper is dependent upon the thoroughness with which the equipment has been designed with this point in mind, the time required being usually very short, mostly occupied with running the gas line from the meter and installing the thermostat and 110 volt electric wiring to the motor valve.

Some cities make a practice of this installation as a separate item having an agreement or contract with a local electrical dealer to install these at a fixed price including all material for the 110 volt connection, switch boxes, fuse block, conduit, etc.

The installation cost of the burners depends of course upon the labor rates, the type of men employed, etc., and varies for different localities. It is customary for two men to install two burners a day where proper distribution of material is made to them. In other words, the plan usually followed is to have two or more crews working from one truck, the truck leaving the burner and all materials necessary for the job at each house in the morning and then going back to the plant or warehouse and loading up for the afternoon trip. The truck then returns to check up on additional supplies that the installation men require and begins to pick them up at mid-day after they complete the jobs and leave them on the new location. One foreman usually supervises five to seven installation crews.

With some organizations it is the practice to have the foreman adjust the burner and check the draft, etc. By far the better method though is to have the inspector responsible for these duties. This man circulates around to these jobs a day or two after they are installed and before they are turned over to the customer, presuming that the installations have been made during the warm weather, checking up on the radiation of the house if it has not already been estimated by the Sales or House Heating Engineering Department and sets the burner according to the demand required, checks the adjustment, checks the thermostat, safety pilot, etc., and instructs the customer in the rudiments of operation.

Customer Instruction

This instruction to the customer in many companies is minimized purposely. The telephone number is added to a caution card hung up beside the burner which outlines the various steps for lighting or turning off the burner, providing it has been completely shut off, but stresses that a call to the gas company will bring out a service man who will light or turn it off as the customer desires.

Oft times the person who has been instructed in operating it is away and the person who is attempting to operate it is wholly ignorant of the principles involved, and will pay no attention to the caution card. Therefore, in line with the idea of completely automatic heat with gas this simple duty of turning on and off burners should be considered as one of the responsibilities of gas home heating.

Periodic Service

It is not to be forgotten also while we are speaking of this service, that any piece of mechanical equipment requires overhauling periodically, not necessarily with the idea of replacing parts but to insure that the parts are all in operating condition. Every conversion burner installation made should be checked over during the summer months either immediately after the heating season or immediately before, preferably immediately after so that the fall months may be utilized for installation of new jobs. This checking of a burner consists in tracing over the wiring, checking the thermostat adjustments, checking the pilot adjustments, cleaning out the venturi throats, checking the operation of the motor valve, secondary air door and if necessary with the particular gas encountered, removing the regulator seat and valve stem and cleaning it thoroughly with Benzol or other solvent to remove the traces of tar which accumulate in these pieces of equipment. Oft times a burner is cited as having gone out of commission repeatedly day after day and usually this is due to the sticking of a regulator with tar in such a manner that as the burner calls for heat and the regulator remains closed for an instant, the pilot light is starved, going out and causing the equipment to become inoperative until it is relighted.

It is always necessary to examine the interior of the furnace to see that the customer has not been burning trash or rubbish over the burner heads, causing the ash to fall down and cover the burner ports. This has been found to have happened in rare instances where the difference between the coal fire and a gas fire is not appreciated by the customer.

With these few points in mind and perhaps the occasional retouching of the appearance of the job with a little black enamel or aluminum paint, it is very easy to build up a feeling of confidence between the customers and the gas companies which promotes and fosters the idea that completely automatic heat is gas heat and that when the furnace finally needs replacement, a live prospect is waiting to receive a gas designed piece of equipment.

Legislation Bearing on Utility Merchandising

THE following information has been collected in part by the Joint Committee of National Utility Associations, and brought to date by A. G. A. Headquarters:

In twenty-seven states where Legislatures are in session no bills have been introduced concerning utility merchandising.

In three states, Louisiana, Mississippi and Virginia, there is no legislative session this winter.

In nine states bills have been introduced upon the subject of utility merchandising, namely, California, Indiana, Kansas, Missouri, Nebraska, Nevada, Oklahoma, Pennsylvania and Texas.

The Nevada bill prohibited the sale of any article, commodity or appliances, except in the conduct of the utility business. The California bill is identical, The Kansas, the Missouri and the Nebraska bills are identical. They provide against the sale of any chattel, article, commodity or manufactured product by a utility company. The Oklahoma bill prohibits the sale of fixtures, instruments, apparatus or appliances.

The Kansas bill has been passed by the Legislature. The Missouri bill has been recommended for passage by the House Committee. The Oklahoma bill has passed both Houses. The Nevada bill is dead. Indiana adjourned without action. No action has been taken on the other bills, at least to the extent of recommending them for passage.

This information is accurate as far as can be ascertained up to and including March 20, 1931.

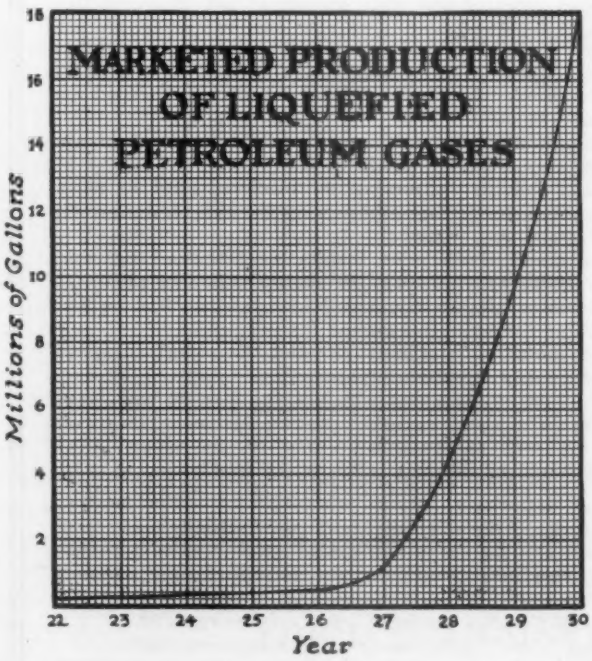
Growth in Production of Liquefied Petroleum Gases

MARKETED production of liquefied petroleum gases, principally propane and butane, during 1930 reached a total of 18,017,347 gallons, an increase of 81.4 per cent over the 9,930,964 gallons marketed during 1929 and nearly 300 per cent greater than the 4,522,899 gallons marketed during 1928, according to the United States Bureau of Mines, Department of Commerce, following the completion of a survey of 1930 operations by E. B. Swanson, Chief Petroleum Economist. The first survey of production, completed in June, 1930, reported the quantities marketed annually from 1922 to 1929, inclusive.

Marketed Production of Liquefied Petroleum Gases, 1922-1930

Year	Gallons
1922	222,641
1923	276,863
1924	376,488
1925	403,674
1926	465,085
1927	1,091,005
1928	4,522,899
1929	9,930,964*
1930	18,017,347

** Revised*



An approximate segregation of the gases marketed indicates that the 1930 distribution of propane was in the neighborhood of 11,500,000 gallons, virtually twice the 1929 distribution, while the distribution of butane, isobutane, pentane and butane-pentane mixtures used for comparable purposes, reached a total of about 6,500,000 gallons, approximately 50 per cent more than during 1929.

It is estimated that 117,000 customers were served with propane during 1930 as compared with 55,000 in 1929 and 20,000 in 1928. The indicated average consumption per installation was 98.6 gallons.

Several communities in California, Oregon and Washington during 1930 received their first gas service through the medium of butane plants, while the number of such plants in the remainder of the country also continued to increase.

Individual gas systems, in which air is passed through the pentane container, supply a mixture of air and pentane which is used to a considerable extent in individual dwellings. Approximate data relative to the distribution of pentane for this purpose indicate a substantial increase during 1930 in the number of installations of such gas systems.

The producers of liquefied petroleum gases operating during 1930 and reporting distribution to the Bureau of Mines were identical with those reporting for the preceding year. Although a number of companies indicated an interest in the possibilities of producing liquefied petroleum gases, no additional producers were reported. It is probable, however, that the number of local distributors of these gases increased.

Texas Supplying Vast Quantity of Natural Gas

TEXAS has just completed its greatest season of supplying natural gas to other states, the peak of the winter season seeing natural gas going from the Panhandle of Texas to many industrial plants and to thousands of homes in the Middle West. Pipelines that tap this huge reservoir of potential power, covering millions of acres in the Texas Panhandle, spread a net work that touches the industrial centers of a dozen states, from Colorado to Indiana and Kentucky.

This section of Texas, within the last five years, has seen the building of nine major pipelines, forming a 5,500-mile network, not including tributaries, representing an investment of at least $300,000,000. There are but few of the lines awaiting connections at the wells, while the tenth line, of approximately 1,000 miles, is under contract. Still others are proposed.

Pipeline construction of this section has been a salvation during the last twelve months, affording employment for thousands, as well as keeping up steel orders.

With the completion of all of the lines, more than 600,000,000 cubic feet of natural gas will be carried out of the Panhandle daily. The field from which the gas is obtained is more than 100 miles long and averages 20 miles wide. The area is estimated to be about 20 to 25 per cent developed. Engineers estimate the total resources of the field at 111 million billion cubic feet.

While so much of the gas is being piped away, Texas, too, is using its part of the product. A billion cubic feet a day is run through gasoline extraction plants in the field, where 800,000 gallons of gasoline are manufactured daily. The residue gas, then, is used in the manufacture of carbon black, which has sprung up to become one of the state's leading industries. Approximately 100,000 tons, or an estimated 55 per cent of the world's supply, is produced annually in the Panhandle section of Texas.

AMERICAN GAS MERCHANDISING ALMANACK

May

THE Merry Month of May will bring a constant ringing of the cash register to the gas man who has planned his work. May is the month when the home manager wishes to go places and see things; it is the month when the bride-to-be does her shopping; when pa wants to play and have an early morning bath. He don't have to excuse himself now, because the house is too cold to shower so much water about his person. Oh! to be sure, we are assuming that there is automatic hot water service in the home.

The month of May is the month of the Lily of the Valley, Emerald is the color for the month. It is the month when decorations should be in pastel shades, save on such occasions as Mothers' Day when they may be red and white, or on Memorial Day when they should be red, white and blue.

May-pole windows fit-in in May, and pink and white should be the color scheme for such displays.

May however, to the gas man is Automatic Water Heater season and unless he has a particular urge to build some special window display advertisements for Decoration Day and Mother's Day he should devote his windows to the promotion of Hot Water Service. Elsewhere in this issue of the American Gas Journal will be found suggestions for effective gas water heater window display advertising.

1 — Fri.	May Day; moving day—**the day the gas man opens his Spring Harvest sale of Water Heaters.**
2 — Sat.	**General check-up** on all details of sales activity. **Schedule and recheck "Sale is on" newspaper advertisement.**
3 — Sun.	**Get ready to "knock off" some real sales tomorrow.**
4 — Mon.	**Sale on in Full Swing.** Shanghai and Hong Kong, China, were first lighted by gas in 1862.
5 — Tues.	**Re-read second newspaper ad. "Only $5.00" and send to newspaper.**
6 — Wed.	**Check-up see that advertisement appears in newspaper.**
7 — Thurs.	**Check-up "18 Months to Pay" advertisement and send newspaper.**
8—Fri.	St. Louis, Missouri first used gas in 1846. **Meeting with salesmen to check results of sale.**
9 — Sat.	**Check-up of floor and window display to see that they are clean and orderly. Talk with floor sales people. Get out letter to employees urging them to take advantage of special purchase plan.**
10 — Sun.	**Check over newspapers to see if "For Dishes" advertisement appeared and what position it had.** Mother's Day.
11 — Mon.	**Check over prospect cards and look over employee survey sheets. Talk to service department about prospects.**
12 — Tues	**Get "Bath" advertisement ready to send to newspaper. Check-over displays see if new display is finished and ready to install.**
13 — Wed.	**See if truck banners are in good shape, clean and properly used.**
14 — Thurs.	**Get "Shaving" advertisement ready to send to newspaper. Arrange for window displays and rearrangement of store floor tonight.**
15—Fri.	**Look over new window displays and store arrangement. Creck-up with salesmen on second period of sale.**
16 — Sat.	President Lincoln nominated 1860, and he had no Hot Water Service in his home.
17 — Sun.	Benjamin Franklin died 1790. **Get "Cleaning" advertisement ready for the newspaper.**
18 — Mon.	**Check-up on employee activities and sales to employees.**
19 — Tues.	Gas sold for $2.75 per M. cu. ft. in Baltimore, 1870-1876.
20 — Wed.	**Get "Cost" advertisement ready for newspaper.** Col. Chas. A. Lindbergh started for Paris, 1927.
21 — Thurs.	Windsor obtained first English patent for gas making apparatus 1804.
22 — Fri.	**Check-up on sales for third period. Impress everyone with the fact that the special sales period is rapidly drawing to a close and insist upon necessity of closing more sales.**
23 — Sat.	South Carolina ratified U. S. Constitution 1788.
24 — Sun.	**Run "Cost" Advertisement in newspapers today.**
25 — Mon.	**Meeting for general "how" to close existing prospects.**
26 — Tues.	Al. Jolson of "Mammy" fame born, 1886.
27 — Wed.	**Run Advertisement "Only Three More Days."**
28 — Thurs.	**Get "Saturday Last Day" advertisement to newspaper, paste proofs of same about office and in windows.**
29—Fri.	**Sale is drawing to close time to give some thought to June activity, to check-up and see if plan is ready to present to organization.**
30 — Sat.	Decoration Day—holiday—for everyone save the sales manager.
31 — Sun.	Battle of Seven Pines and Fair Oaks, Va., 1862.

THE OUTSTANDING DEVELOPMENT IN CARBURETTED WATER GAS MANUFACTURE

* * *

THE U.G.I. HEAVY OIL PROCESS

(Patented)

As successfully used at Philadelphia, Newark, Atlantic City, Norwalk and New Haven, Conn., and Long Branch, N. J.

* * *

We shall be glad to discuss the savings which the U.G.I. Heavy Oil Process makes possible in your plant.

THE U. G. I. CONTRACTING COMPANY

DIVISION OF

UNITED ENGINEERS & CONSTRUCTORS

INCORPORATED

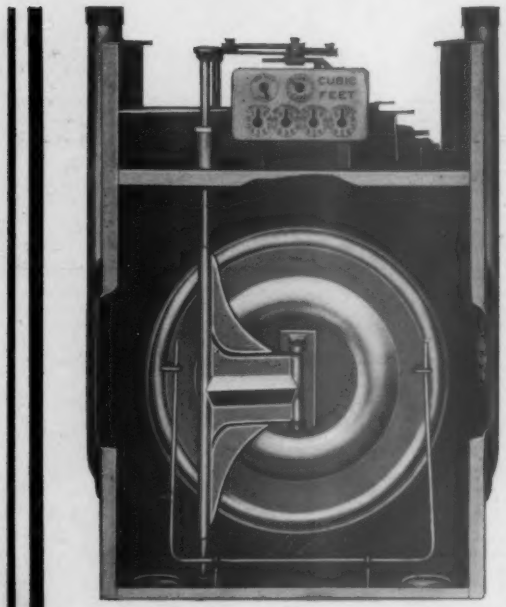
DWIGHT P. ROBINSON, PRESIDENT

Philadelphia
112 North Broad Street

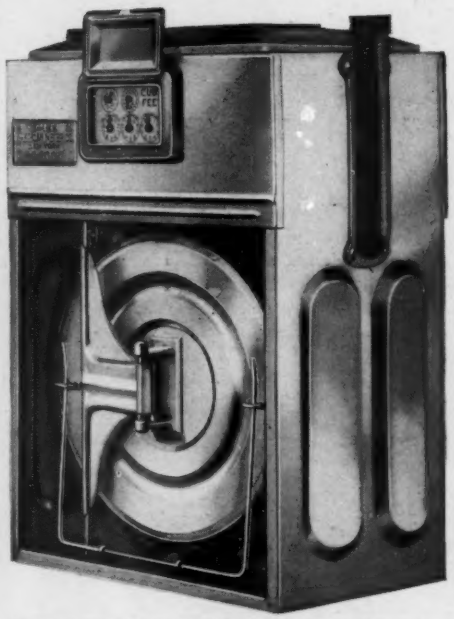
Chicago
Conway Building

MAXIMUM RETURN TO CLIENTS PER DOLLAR INVESTED

Also C type meters (tinned steel case). Capacity range—600 to 17,500 cubic feet per hour. Six sizes.
Metric Iron Case Meters, Orifice Meters and Testing Apparatus



A type meters (tinned steel case). Rated capacity range—175 to 3400 cubic feet per hour at ½" differential. Five sizes.



B type meters (tinned steel case). Rated capacity range—150 to 7500 cubic feet per hour at ½" differential. Eight sizes.

Gas Meters that are not duplicated

AMERICAN METER COMPANY Gas Meters have every known requirement for true economy.

Collectively, these meters cover the entire range of Gas Company needs for measuring manufactured or natural gas. The line is complete. And the varying requirements of each section of the country are served by a manufacturing plant or a service station located in that area.

Individually, each meter has every quality necessary for accuracy and dependability—proper design and construction—proper metallurgical composition of parts—precise assembly—efficient operation.

Only an exact duplication of each feature in every detail can give an equivalent value.

High quality is true economy. American Meter Company Gas Meters will measure your Gas at lower cost. A nearby representative will be glad to discuss this with you.

AMERICAN METER COMPANY
JOHN J. GRIFFIN & COMPANY
HELME & McILHENNY
MARYLAND METER WORKS
D. McDONALD & COMPANY
METRIC METAL WORKS
NATHANIEL TUFTS METER WORKS
PACIFIC METER WORKS

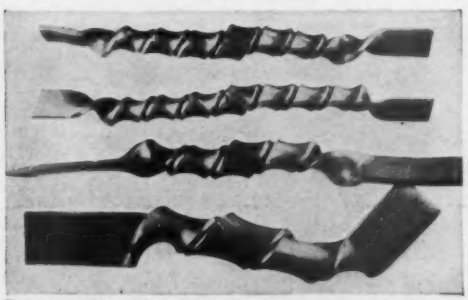
AMERICAN METER CO. MEASUREMENT ENGINEERS CUBIC FEET

AMERICAN METER COMPANY
INCORPORATED
The World's Largest Manufacturers of Gas Meters and Allied Apparatus
ESTABLISHED 1836
GENERAL OFFICES : 105 W. 40TH STREET · NEW YORK, N.Y.

SALES SERVICE ALBANY · BALTIMORE · BOSTON · CHICAGO · DALLAS · DENVER · ERIE · KANSAS CITY · LOS ANGELES · NEW YORK · PHILADELPHIA · PITTSBURGH · SAN FRANCISCO · TULSA

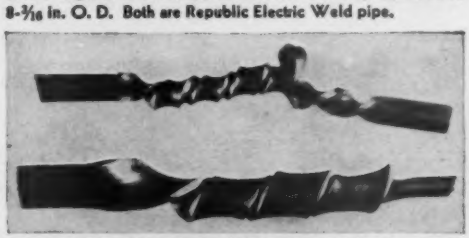
WHY REPUBLIC *ELECTRIC WELD* PIPE WITHSTANDS PUNISHMENT IN THE FIELD...

Tensile test on strip cut from Electric Weld pipe. Note the ¼ in. diameter notches at the weld. Break did not occur at weld.



Twist test with weld at right angles to axis of test strip. Two upper test pieces are from pipe 6-⅝ in. O. D. x 0.218 in. Two lower are 6-⅝ in. O. D. x 0.250 in.

Pipe A is 6-⅝ in. O. D. x 0.250 in. thick, expanded to 8-⅜ in. O. D. Pipe B is 6 in. O. D. x 0.156 in. thick, expanded to 8-3/16 in. O. D. Both are Republic Electric Weld pipe.



Twist test with weld longitudinal through center. Upper test piece is 1 3/16 in. wide and has been given seven twists; lower is 1-½ in. wide, given four twists.

Vanstoning quality of electric weld pipe 6-⅝ in. O. D. x 0.250 in.

Only those who have had intimate contact with pipe line work know the variety and the extent of the stresses to which line pipe is subjected in use and during handling.

Engineers and field men who know from experience the value of high tensile strength and ductility, and the advantages of uniform wall thickness and proven welds, will be interested in the results of the tests illustrated here.

While the usual hydrostatic and crushing tests are sufficient for the protection of the buyer in routine pipe production, these "abuse tests" are of value, illustrating as they do the unusual qualifications of Republic Electric Weld pipe, proving its strength of metal and weld, its ductility, its working qualities and its ability to take punishment in the field.

Details gladly mailed on request.

REPUBLIC STEEL
CORPORATION
GENERAL OFFICES: YOUNGSTOWN, OHIO

SUPERIOR MATERIALS
The quality of any product has its foundation in the quality of its raw materials. EMCO uses only the finest materials safeguarded by our own chemical and physical laboratories.
EXPERIENCE
45 years of experience in producing quality meters and regulating equipment for the gas industry.
DESIGN
Pioneers of ideas—(1) rolling type diaphragm (2) one piece body casting (3) removable valve plate assembly (4) pressed steel case (5) interchangeable parts, etc.
ORGANIZATION
The Pittsburgh Equitable Meter Company, manufacturers of the largest and most complete line of meters and pressure regulating equipment in the world, employs over 2,000 and uses the most modern manufacturing equipment to enable these employees to build only the finest products.
SERVICE
Trained engineering field staff, competent sales representatives, experienced engineers, and 12 strategically located branches with stock points, all go toward giving better service to the gas industry.
PITTSBURGH EQUITABLE METER COMPANY

Make 'em Hot Water Conscious!

MAY is the ideal month for the gas man to stage his initial drive to secure converts for Automatic Hot Water Service for the home, and if we are to awaken their interest, we must work fast and furious and employ every vehicle known to modern sales promotion to implant the desirability of such service and do it immediately and in such a manner that every other competitive element will be more or less secondary. Also we must do the job thoroughly, for if we do not get them to buy during the month of May we must do it in a manner that will at least get their name on the dotted line before Christmas.

Our plan in detail will dwell upon a thirty day activity and is predicted upon the idea that selling Automatic Hot Water Service to the home should be *a continuous activity, laid down for a period of from three to five years.* It is our opinion that plans that visualize activities of such duration will prove very effective in many respects, and while the original plan of carrying-on may have to be modified or completely changed several times during such a period, the mere fact that we have a plan and are working according to plan will prove most advantageous.

A plan laid out for such periods of time should take into consideration the best approved merchandise, the potential market of today, the growth and development of new markets, method of marketing, dealer co-operation, employee user and employee sales assistance plans, continuity of advertising, improved sales methods and training, customer and employee education, using the user plans, added M cu. ft. per domestic meter, fair prices and terms such as earn a profit, and many other phases of modern merchandising. These plans should also be taken into consideration in planning sales for the present year and in operating a thirty day activity and the following outlines some suggestions along these lines as they may be applied to a thirty day starting activity.

How one gas man secured tie-in from a druggist

How one Plumbing Company Sells Water Heater, J. D. Flinn, of Robinson Bros., Pine Bluff, Ark., demonstrates a gas water heater to a prospective purchaser

This plan is designed to sell 40% of the total of a year's quota (12 calendar months) of Automatic Gas Water Heaters by an intensive activity during the month of May; the activity to start with an "Early Bird Breakfast" at which all interested employees and sales people, together with the sales manager and other executives, are to be present. The plan will be outlined at this meeting and everyone present will be given a "working kit" for his or her use during the activity.

The activity will close with a rally on the evening of May 29 where final results will be announced and awards made.

The merchandise to be featured to be only such appliances as have been approved by the American Gas Association Testing Laboratory.

Prices and terms shall be such as will enable the gas company as well as any dealer to earn a fair profit. Terms call for a reasonable initial or down payment with order and monthly payments extending over a period not to exceed (18) eighteen months. All deferred payments to bear a carrying charge equal to 10% of the remaining unpaid balance, after down payment has been made.

Compensation to regular sales people will be the same as is now in force, together with added bonuses and prizes, during this period, as hereinafter outlined.

Bonuses in our plan will consist of the payment of $1.00 above the regular compensation and an opportunity for special prizes, for each heater sold by an outside salesman. Some sales executives may wish to set-up a definite sum of money for the men who sell the greatest number of heaters in a given period, or for those selling the greatest dollar value, or selling a heater each day. Others may prefer to operate on the point system wherein each dollar cash value entitles the salesman to a credit of a fixed number of points, usually two, for each dollar sales, which may be applied to merchandise prizes. Catalogs for use with such plans, as well as merchandise, may be obtained from the Dartnell Corporation of Marshall-Field and Company, Chicago and others. The merchandise plan is preferred by many salesmen for the reason that the articles are all first-class, wanted merchandise that will be appreciated by wives, children, parents and friends. Where this plan is used the wise sales manager will

see to it that the catalog is sent to the salesman's home.

In our plan we will use the merchandise plan and in addition, offer as a suggestion the "Cleanvenience" prizes as outlined. This plan calls for a large chart on which has been lettered:

Sixty dollars will be set-up on this contest—forty-five $1.00 prizes, one $5.00 and one $10.00 prize. The contest will be open only to outside salesmen. Every time an outside salesman brings in an order for a gas water heater that gets the credit department's OK he is entitled to write himself a ticket for $1.00 (write his name on the chart). The man who writes his name at the "C" start of the word "Cleanvenience" will receive $5.00, regardless of the number of heaters he has sold. The object of course, is to boost sales up to that point. The man who sells the 45th heater will receive $10. When 45 heaters have been sold a new chart will be put up and operated on the same basis. On the other hand, if only 44 heaters are sold during the period of the activity only $45.00 will be paid out in prize money on this plan. This plan is designed to put a little extra push and play into the activity. Where the amounts seem too large it is recommended that they be decreased and used for that little extra money which will speed up efforts and sales.

Employees will be used during this activity as sales aids; their job will be to turn in the names of friends and acquaintances to whom they have talked about the advantages of having Automatic Hot Water Service. (Make this clear, otherwise a great many names will be turned in that are wholly valueless and simply waste the salesman's time who calls upon them). Employees will be paid a commission of $5.00 for all leads turned in during this period which results in a sale during the activity.

Special attractive employee-user prices and terms will also be offered to all employees during the period of this activity. A canvass of all employees will be made and all those owning their own homes and all family heads will then be solicited to purchase an automatic water heater at the special price.

A "Use the User" plan will also be conducted by the outside salesmen and by the floor sales people by telephone. The users plan will be an approach to ascertain how the user likes automatic hot water service and to secure names of friends who may be interested in having such service. The user is to be compensated if the names supplied are sold during the activity. A special users card will be made out and turned over to the salesmen by the sales-manager each morning and it will be his duty to visit the users and report on them each evening, turning the cards back to the sales manager.

The drive should be announced and kept alive by a consistent newspaper advertising schedule built somewhat along the lines as laid down at the end of this article.

Where direct mail advertising is to be employed it is recommended that the method of handling it be very carefully planned and that the plan be conformed to the last detail. If cards are to be used (and that is our choice) we suggest that a series of at least five be used, and in connection with a sixth piece in the form of a folder that ties-up the heater, the plan of sale and the cards and opens the way for the salesman's call. Unless the plan includes and schedules a salesman's call immediately after the customer has received the sixth mailing you've wasted a lot of fine ammunition, an excellent opportunity to sell the idea of Automatic Hot Water Service for the home and possibly an immediate order for an automatic gas water heater.

In our plan we recommend other forms of advertising; day and night (painted) bulletin boards, truck banners, store and window display advertising, and special demonstrations. During the period of this activity effective window displays should be built at the start of the activity, with changes planned for sometime about the middle of the month. Store displays should be arranged for and a grouping of heaters on the sales flor, with prices plainly marked on special tags. Store banners and cards should be part of this display.

Pile-up, so to speak, the floor with heaters; the more the better. When you lead folks to believe you expect to sell, they buy. Store displays may also include special demonstrations and decorative booths—get some of the theatrical into your selling scheme; cards, colored lights, pedestals, etc. In our plan we do not play up premiums, however there are any number of kindred items that may be used as premiums. If such are desired, lists may be secured from the heater manufacturers. We do not think it a capital idea to give an allowance for furnace coils and old heaters during such an activity, the amount of the allowance to be deducted from the full price of the heater.

. . . . "When Grandma Was A Girl"
The good OLD days
. . . the old tin bucket occupied an important place in the family kitchen.
It carried the water to wash the clothes and the dishes, and constantly was being called upon to meet the responsibilities of clean housekeeping.
It has served its purpose and has retired to the dim background of fading history, along with the other obsolete methods of other years.
Man and modern ingenuity has piped the water to the house for the kitchen, bath room and laundry, and . . .
Natural Gas Will Make It Hot
UNTIL MAY 15th
we are offering any
Ruud - Pittsburg Water Heater
in our stock for
$2.00 DOWN
Balance Monthly with Your Gas Bill
As a Special Feature of this Campaign, we are giving a Beautiful and Worth-while Premium FREE with each Heater.
COMMUNITY NATURAL GAS COMPANY

How the Natural Gas Man Says use Hot Water Service in your home

Believe It Or Not!
Someone must scrub five miles of floor each year in the average home.
Is that someone you? Then let GAS service help you with this tiring task. Automatically it will bring you an abundant supply of steaming HOT water to make your scrubbing easier. Cleaning from two to twenty times faster HOT water will also save your time. Before you scrub again, let one of our representatives call and tell you how the modern GAS storage heater will bring you an inexhaustible supply of hot water always ready to flow at any time of the day or night. You will be under no obligation. Just phone today.
GAS
Associated Gas and Electric System

How the Associated Gas and Electric System advertises Hot Water Service

Announcement ad Sunday before sale opens		6 col. x 300 lines	1800
May 3	Newspaper ad. "Sale Is On"	4 col. x 150 lines	650
May 6	Newspaper ad. "Only $5 Down"	3 col. x 150 lines	450
May 8	Newspaper ad. "18 Months to Pay"	3 col. x 150 lines	450
May 10	Newspaper ad. "For Dishes"	3 col. x 150 lines	450
May 12	Newspaper ad. "For Bathing"	3 col. x 150 lines	450
May 15	Newspaper ad. "For Shaving"	3 col. x 150 lines	450
May 18	Newspaper ad. "For Cleaning"	3 col. x 150 lines	450
May 21	Newspaper ad. "For Health"	3 col. x 150 lines	450
May 24	Newspaper ad. "Costs Only"	3 col. x 150 lines	450
May 27	Newspaper ar. "Only 3 More Days"	5 col. x 200 lines	1000
May 29	Newspaper ad. "Last Day Saturday"	3 col. x 200 lines	600
	Total		7650

Note: Last day may be changed to Friday if store is closed on Saturday.

Helping The Serviceman

GRACE REBMAN PRESTON

WITH a greater number of heat controlled ranges being sold each year to experienced and inexperienced cooks, the man setting that range into the home has been faced with many cooking problems, much to his dismay. In some companies, he has been able to turn the many questions over to the Home Service Department for answering. But in many companies there is still little home service help and he has had to worry along as well as he could, probably using his wife or mother as consultant. Feeling the need for a simple, easily referred to, manual, the following has been compiled to help the serviceman.

It is hardly necessary to go into the need for emphasizing the proper sized pipe connections for all ranges, or the fact that if the oven is connected to a chimney, that chimney must not have too great a down or up draft. Nor is it necessary to emphasize that insulated ranges require the lowest possible maintenance or by-pass flame, while the non-insulated oven may have a longer by-pass. The serviceman will also advise the cook that baking is done on the racks provided in the oven and not on the oven bottom. And now for some of the problems that face the serviceman:

When Baking Goes Wrong

Apple Pie Won't Brown

Oven not hot enough—calibrate heat control adjust maximum and by-pass flames.

Not baked correctly—All pies should be placed in very hot oven 475 degrees for 10 minutes then heat control changed to finish the baking period. Finish baking at 400 degrees for apple pie, 375 degrees for berry pie, 340 degrees for custard or pumpkin pie.

Apple Pie Boils Over

Baked at too high temperature after first 10 minutes.

Upper and lower crusts not properly sealed together.

Too many apples for shallow pie pan—use fewer apples or deeper pie pan.

Biscuits Heavy

Oven not hot enough—calibrate heat control, adjust maximum and by-pass flames; bake at 450 degrees or higher for very tiny biscuits.

Too much shortening used.

Not enough leavening used (baking powder or soda).

Biscuit Crust Too Hard And Heavy

Oven not hot enough.

Too much liquid used.

Place biscuits closer together on baking pan.

Cake Burns

Oven too hot—calibrate heat control and adjust flames.

Cake not baked at proper temperature—see cookbooks or chart.

Cake baked too long.

Cake Burns Unevenly

Cake pans too close to side, front or back oven linings. Allow at least two inches margin.

Cake pans may be too large, filling the oven too full.

Flue trouble—possible obstruction in flue or too much draft. Use draft hood or damper. Change damper position if one is in use.

Cake Raises Unevenly

Too much draft—use damper or draft divertor.

Uneven racks in oven or stove not set level.

Cakes backed too close together on same rack.

Cake batter not spread evenly in pans.

Some inexpensive cake pans are made of metal of uneven thickness. These pans will curl when heated.

Cake Bakes Unevenly In Different Parts of Oven

Calibrate heat control—adjust maximum and by-pass flames.

Too much flue draft—use divertor or damper.

Not enough draft—obstruction in flue either oven or chimney.

Oven racks too close together or too near top of oven. Allow equal space between racks, and top.

Oven over-crowded—allow sufficient space for circulation around each pan.

Cake Is Heavy

Too much sugar, shortening or egg yolks used—measure accurately follow recipe accurately.

Oven not hot enough.

Sponge or angel food cakes may have been overmixed. Cream of tartar or lemon may have been omitted.

Cake Has Heavy Streak On Bottom

Egg yolks not beaten enough.

Cake batter not mixed enough.

Oven not hot enough.

Cake Not Baked In Proper Length Of Time

Oven not hot enough—calibrate heat control and adjust flames.

Deeper pan than usual used—takes longer for heat to reach center of the cake batter.

Cake Falls When Removed From Oven

Not baked for sufficient length of time.

Damp flour used.

Too much sugar or shortening used—measure accurately.

Too much or not enough leavening used—follow recipe.

Oven Roasts Meat But Won't Bake Cake.

Oven too hot—calibrate heat control—adjust flames.

Oven Bakes Cakes But Won't Roast Meat

Oven not hot enough—calibrate and adjust flames.

Cakes Or Cookies Burn On Bottom

Pan or pans fill oven too full so heat won't circulate.
Oven not hot enough—calibrate heat control and adjust flames.
Too much draft—use draft divertor or damper or change damper position.

Cake Or Cookies Too Light On Bottom

Oven racks too close together.
Pans too new—not "seasoned."
Not baked for sufficient length of time.
Not enough draft—possible flue obstruction in chimney or oven.

Cake Or Cookies Burn On Top

Oven too hot—calibrate heat control—adjust flames.
Too much chimney draft—use divertor or damper.
Not enough draft—possible flue obstruction.
Oven rack too close on top of oven.
Baked too long.

Cake Or Cookies Too Light On Top

Oven not hot enough—calibrate heat control and set flames.
Oven racks too close together—allow more space between.
Pans baked directly on top of one another—stagger position best.
Cookies baked in pan having high sides—invert and bake on bottom.
Possible flue trouble—flue may be obstructed and may be too large. Use damper or draft divertor.

Cake Or Muffins Raise In Peaks And Crack Open

Too much flour or not enough liquid—measure accurately.
Muffin batter over mixed.
Oven too hot—calibrate heat control and adjust flames.
Pound cake baked at too high a temperature or in too large a pan having no center tube.

Follow recipes accurately in all baking for best results. Use measuring cups and measuring spoons—level measurements. Always sift flour before measuring and do not pack into cup.

When Broiling Difficulties Arise

Broiling Oven Temperature

Must be hot for best results—heat control at 550 degrees.
Preheat oven at least 5, preferably 10 minutes.
Broiler rack should be preheated.

Broiler Pan Treatment

Advisable to pour about 1 cup boiling water in pan before heating.
This keeps fat from smoking or igniting.
Keeps broiler pan from crazing.
Certain types of built up broiler pans do not need water.

Distance

Place broiler rack so that food surface is 1½-2 inches from flame.

Broiler Door

Keep door closed most of the time—less noise, steam and smoke. No spattering of grease on kitchen floor.

Lowering Temperature

When food is seared (browned) on one side, turn and sear other side.
Change heat control so flame is only half as long as maximum.
Retain half flame for rest of broiling procedure.

Oven Meal Procedure

Searing

Preheat oven to 500 degrees if brown surface is liked on meat.
Place prepared meat in oven without covering for 20 minutes.
Cover meat and place prepared vegetables in oven.
All should have small amount of moisture added.
All pans should have close fitting covers.
When all are placed, change oven heat control setting.

Degrees And Time

250 degrees for long slow cooking or very small amounts of food.
275 degrees for not quite so long a time.
Allow from 3 to 5 hours depending on amount of moisture present.
325-350 degrees for less time or less moisture.
Allow from 1 to 2½ hours depending on amount of food.
350-375 degrees for quicker cooking or less moisture.
Allow from 45 minutes to 2½ hours according to amount of food.

Top Burner Cooking

Boiling

Cooking of food in large amount of water.
Requires hot, high flame to bring up to temperature.
Low flame only required to maintain temperature.

Simmering.

Keeping liquid at a temperature just under boiling point.
Low flame only required.

Stewing

Cooking of food in small amount of water.
Low flame required to keep at temperature of slow boil.

Frying

Cooking of food in large amount of fat at high temperature.

Sauteing Or Pan Frying

Cooking of food in small amount of fat.
High flame required to bring up to temperature.
Low flame will maintain temperature.

Large bottomed cooking utensils most economical for top burners as less fuel is required to maintain temperature. Brand new light tin utensils will not allow food to brown. Season by greasing then placing in 300 degree oven for half hour. Pans just holding the proper amount of food are more economical in use of fuel than pans that are too large.

Here's How

S. C. Whitener, of Hickory, N. C., Narrates an Interesting Story on Selling Gas Refrigerators

SELLING gas fired refrigerators on a small property and with strong electrical competition has been one of the greatest pleasures of my selling experience for several reasons. Having sold electrical merchandise for years in this same territory where now I am selling gas appliances, it seemed when I first started selling for Piedmont Utilities Company that it was impossible to talk gas appliances convincingly. In other words, I did not believe in my product; but after several months' work, I came to realize that this was a new product in this section, not only to me, but to nearly every one that I came in contact with. Therefore, I began to study the gas industry and what it has stood for all these years.

One of the first gas appliances that I became familiar with was the Electrolux Refrigerator, and, as I stated in the beginning, having sold electrical refrigerators and knowing them as you would know a book after the second reading. I found the gas fired refrigerator one of the simplest in operation and the easiest to understand of any. The result was I became sold on gas refrigeration.

As every salesman knows, the law of average is in his favor. In other words, the more calls he makes during a day, the more he sells. Canvassing is becoming more difficult every day, due to the increase in the number of foreign countries that are using this direct method of selling more each year, and, therefore, it has rendered it more difficult for the local salesman to obtain access to the householder to present his sales proposition.

The reason for this growing difficulty in obtaining an interview is readily understood. Frequently, the householder tends to resent the increasing frequency of interruptions, and entirely irrespective of the personality of the salesman, or his approach, is apt to be prejudiced against him, merely because he constiutes one of several who have interrupted the prospective buyer, when he or she wished to devote time to other things. The salesman must realize that since the merchandise he sells carries with it repeat orders, the work of the salesman in building up good will, regardless of how small the sale, will bring increased earnings in future sales, and therefore he should invariably make an appointment by 'phone, where possible, before calling. I have always called on at least ten prospects daily, either new prospects or follow-ups.

Get Sample of Card

At the beginning of last year, we had installed Kardex color card system for prospects, and at the end of each day's work, I always write in the remark column on this card exactly the reaction of each prospect. I also keep at least 10 or 15 broadsides in the mail to my future prospects who are to be called on each day in order that I may have an entering wedge for my sales talk. In this way it has been possible to follow up each prospect at the phsychological time. The majority of my sales have been made at night, because I have always found that by getting both husband and wife together they cannot pass the buck from one to the other, as is invariably the case where you try to sell them separately, and it not only makes a quicker sale, but it saves time and energy.

Get Sample of Testimonial

I have my first Electrolux to sell where I cannot go back at any time and get a testimonial from the user, and I have used nearly all of my refrigerator customers for this purpose at various times. Several months ago, I had made an appointment by telephone to call on a prospective buyer for an apartment house that evening. Before going over, I called five or six of my customers and told them where I was going and would possibly call them from there for a recommendation on the refrigerator. That evening during the usual sales talk my prospect wanted to know how many we had in use and some that were using them, so I gave him the names of those I had called in advance, and insisted that he call them immediately, which he did. The result was I came away with a signed order for eight refrigerators and eight ranges. My object in citing this instance is to show how valuable night work is because the next morning the electric salesman was very much taken down when he called and found he had lost a nice order by waiting for the dawn.

During the refrigerator campaign last Summer, we sent out to all refrigerator customers a letter telling them of the campaign and offering to let them submit to us as many names as they wished, and for every name that they submitted, on which we made a sale, we would give them a check for ten dollars. In this way we not only built up our prospect file for future reference on refrigerators, but found lots of prospects for other equipment. We found that they would not only call the prospects up to talk to them themselves about gas refrigeration, but were continually bringing this subject up at all kinds of social gatherings, and, by doing so, were giving us the kind of advertising that we could not buy in any other way.

I have always tried never to make a call on a prospect

without carrying a copy of the Saturday Evening Post and the Electrical Refrigeration News with me, and have found them both great helps, due to the fact that The Saturday Evening Post gives you the new advertisements and cuts of refrigerators. The Electric Refrigerator News is a paper that gives all the latest news of all the electric machines, and nearly always carries a page ad on what the larger gas companies are accomplishing with the Gas Refrigerator, and usually carries pictures of some of the most important buildings that have just been equipped with Electrolux.

I have heard gas salesmen from other companies say they could not sell this prospect, or that one, as they have electrical merchandise. Well, all I can say is that it is not the story on this property, for there is nothing that I have found easier than trading for electrical equipment, for you can offer them something that they have never had before and something that the electric companies cannot furnish at any price, namely, the following: No moving parts, no machinery, nothing to wear out or get out of order. On the Piedmont Utilities Company's property, electric refrigerators and ice boxes are our meat, and we will take out more of them this year than we did last, although we have replaced this past year twenty-five (25) electric refrigerators of all makes and thirty-five (35) ice boxes with gas refrigerators.

I attribute my sales of Electrolux refrigerators to the following: Being sold myself, knowing my competitors' product, as well as my own, low gas rate, cooperation of each employee of the company, and last, but not least, calling on the prospective buyers at the right time,—sticking to them until they purchase, and if necessary giving them a thirty day approval job and convincing them, in their own home, that there is no other machine like it.

In conclusion, I wish to say that if any one wants an argument, just let them start talking of refrigeration where I can hear it, and if they have an electric unit they will change, or if they have not, they will buy gas, for I believe that the gas refrigerator is going to act as the monkey gland to the gas industry of the future, or, in other words, it will rejuvenate it to such an extent that you will hear more and more of the gas refrigerator every year.

Load Building with Flueless Gas Boiler

A NEW type of gas boiler for process steam work has recently been placed on the market and is of particular interest because of its unusual design and construction. The boiler may be classified as a vertical flueless, but sufficient heating surface has been uniquely built into it to permit of gas being used for fuel. The manufacturer claims that thermal efficiency tests have proven this new boiler equal in efficiency to the vertical tubular type, and that in many comparisons it has shown even more efficiency.

Heating surface has been obtained by pressure welding a great many arch shaped heat conductors to the outside of a boiler shell and these are in number close to one hundred for each boiler horsepower. Around the entire shell and arches is dropped a heavy double insulated jacket of steel construction. This jacket extends to the floor. Within the jacket the boiler shell is supported at sufficient height to permit placement of the gas burner.

The hot gases of combustion first strike the bottom of the shell or crown sheet, then travel upward between the shell and the insulated jacket. The multitude of arch shaped heat conductors in this space intercept the hot gases and carry the heat to the shell.

It seems apparent that the object of this type of construction is to obtain the thermal efficiency of the tubular type boiler and combine this efficiency with the long life and care free performance of the ordinary flueless type boiler. The manufacturing problem involved seems considerable, but not unreasonable, and this boiler should find a considerable market in the great middle west where feed water conditions are so unsuited to small efficient boilers.

Experience has shown that in many localities the use of small industrial gas boilers has been greatly restricted for live steam operation. To obtain satisfactory efficiency very small tubes or flues have been used. For boilers up to four horse power one inch tubes have been standard, one and one-quarter inch in five to twelve horse power, and one and one-half inch up to thirty-five horse power. The average life of a set of these small flues on live steam operation in the Mississippi Valley has probably been close to twelve months. Certainly not much over that. A prospective user on finding this out was no longer a prospect. An owner did not repurchase, for he was like the little boy who had touched the hot stove.

Thousands upon thousands of small flueless coal boilers are in use in the garment press shops throughout the country. Not, in so many cases, because of low first cost, but primarily to get away from persistent flue trouble. Gas boilers meant flues, and flues meant trouble.

A flueless gas boiler should open a large field for industrial gas, not only in the press shops, but in the bakeries, restaurants, bottling plants, hospitals and where not. Ninety-seven installations of various sizes of industrial gas boilers of the tubular type make a nice load for the gas company in one town of fifty-five thousand people. A flueless gas boiler should widen the market considerably.

There is a powerful element however, which tends to interfere with the development of this market. It is industrial gas rates. A known example of inconsistency is the case of a gas heating boiler in the basement using twelve hundred feet at fifty-five cents, and on the floor above is a five horse industrial gas boiler using three thousand six hundred feet at one dollar and one cent. This inconsistency is not exceptional by any means. It almost seems a rule that gas companies will break their necks to get heating load at low rates, but an industrial load to consume gas in summer as well as winter is held at arms length by high rates. From this distance it would seem that a year around industrial load was just as attractive as a seasonable heating one.

The possibilities of the herein described flueless industrial gas boiler seems just as interesting from a load building standpoint as the possibilities of the heating boiler. Comparative rates for fuel would without doubt help enormously in attracting the industrial load heretofore "not interested."

EQUIPMENT NEWS

New Tycos Compensated Tubing

The Taylor Instrument Companies of Rochester, N. Y., have produced a new type of capillary tubing in which the compensation qualities have been incorporated in the material of the tube itself. No parts are added to the mechanism of the instrument, and no adjustments are necessary during the life of the instrument.

It eliminates possible error in the functioning of temperature instruments, due

to external temperature conditions surrounding the tubing connecting the bulb to the instrument itself.

Essentially the new method consists of so proportioning the volume of mercury in the tubing to its co-efficient of expansion and to the size of the alloy wire, that any change in the volume of mercury, resulting from external temperature changes is accurately compensated. For this reason the adjustment is made for each varying exposure, and it is not necessary to compensate the instrument for the average external condition along the length of the tubing, a difficult, if not impossible adjustment to make.

To make this new development possible, it has been necessary for the Taylor Instrument Companies to devise entirely new methods of producing the steel tubing, and the finished product is controlled from the standpoints of material, physical properties and accuracy of bore, within extremely close limits.

This new 7/32" O.D. compensated tubing is the latest step in the development of the efficient TYCOS mercury actuated tube systems. Combined with the rugged welded joints and the bulb of machined alloy steel, it comprises one of the most sensitive as well as the most lasting temperature responsive elements.

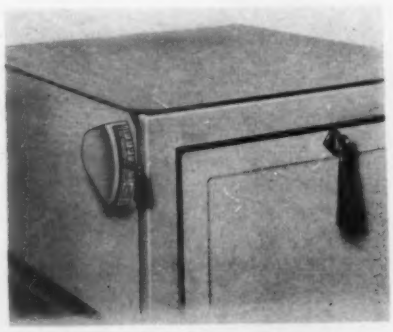
Announce New Oven Heat Regulator

The Wilcolator Company, of Newark, N. J., has announced the introduction of a new Console Model of the Wilcolator Oven Heat Regulator, designed especially for use on console model ranges.

The Console Model Wilcolator protrudes only one inch from the oven side, thus permitting the widest possible use of the cooking top without interference with the heat control.

It is conveniently operated by pulling down or pushing up a small handle according to the position indicated as desirable on the full vision temperature chart, with which is combined a modification of the Wilcolator Cooking Chart. The handle remains cool.

The manufacturers state that the new Console Wilcolator is designed especially for use on console model ranges, and accords with the beauty and attractiveness of the new lines of ranges now on the market. It can be finished in any color or combination of colors, to match the



trim on the range of the individual manufacturer.

Descriptive bulletin will be mailed on request.

New Utility Suit

The Utility Garment Corporation, 421-425 Arch Street, Philadelphia, Pa., have recently brought out a waterproof utility suit called "Ute." This may be worn over ordinary clothing with any type of foot protection. These suits are used to advantage by outdoor workers and it is claimed that it is a more practical protection for operators cleaning condensers and boilers.

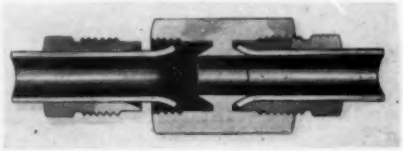
These suits are offered in the one-piece and two piece style and are made of double texture cloth with rubber vulcanized in between. Every seam is cemented and strapped.

Descriptive literature will be sent upon request to the Utility Garment Corporation.

Dieform Compression Fittings and Tubing

Recently the Bailey Meter Company, Cleveland, Ohio, has announced that Dieform Compression Fittings and Tubing are now available for use in small service lines in the power plant and industrial field.

Herewith is shown an exploded view of



a Dieform Tubing Union. The left-hand side of the tubing union is shown with the tube in place and the tube nut screwed down tightly to complete the metal-to-metal joint, while the right-hand side shows the tube nut unscrewed and slipped back along the tubing, which in turn is removed a slight distance from the seat in the fitting. The tubing is securely gripped between the seat in the center fitting and the seat on the tube nut, resulting in a perfectly tight, dry, permanent joint, it is claimed.

In flaring the tubing the Dieform Nut serves as a die thereby assuring a perfect seat with the angle properly proportioned to the size of the tube. The moderate angle of flare, it is stated, prevents the tube from splitting or cracking and also permits the use of hard drawn tube when desirable.

Brass, Monel Metal or Steel Dieform Compression Fittings and Copper or Steel Tubing are especially well suited for piping where many bends must be made in the line and where an absolutely tight installation is required for high pressure and high temperature service.

Double extra heavy brass fittings with extra heavy soft annealed or half-hard copper tubing are suitable for pressures which do not exceed 800 pounds per square inch and where the intermittent temperatures are under 600 degrees F. Where higher intermittent temperatures are expected, steel or monel compression fittings are recommended. Steel tubing should be used for pressures in excess of 800 pounds per square inch if the installation is subject to steam temperatures at intervals, although for hydraulic lines extra heavy copper tubing is satisfactory for pressures up to 2,000 pounds per square inch.

Descriptive bulletin will be mailed on request.

A New Adjustable Tangent

Superior Meter Co., Bush Terminal, Brooklyn, N. Y., announce a new adjust-

able tangent, which has been designed for replacement purposes. It has a new cross feed feature which eliminates the necessity of the prover using a soldering iron to prove or adjust the meter.

Readjust any difference in the front and back valves is regulated by turning one nut only, proof ten per cent and can alter the either way without the tangent having to be relocated on the crank shaft. The cross feed screw works independently of the diapraghm stroke adjustment and is rigidly secured by a lock nut. It insures a positive shift whereas the method of unsoldering the tangent to make a slight change in the open and check tests was sometimes offset by the crank moving at the same time. The assembly is a very ingenious one, and where new Provers are being instructed, will save time.

New Lead and Compound Melting Furnace

The Hotstuf Lead & Compound Melting Furnace, manufactured by the Mohawk Asphalt Heater Company, Schenectady, N. Y., is the latest addition to the

company's line of equipment for the gas industry, and is made in several different sizes and in two models and to meet any requirement.

The Portable Model is mounted on 20 inch wheels with tank integral, and comes in sizes to melt 250 lbs., 350 lbs. and 450 lbs. of lead. It is equipped with ten gallon tanks and Improved Mohawk Burner, which latter is removable for cleaning, etc. This equipment is designed for pipe line jobs and general repair work where the furnace must be moved quickly from job to job.

The semi-portable model is mounted on legs, and both furnace and lead pot have bales provided so that the equipment can be easily moved. This model is made in sizes to melt 50 lb., 100 lbs. and 150 lbs., and is provided with Improved Mohawk Burner and either five or ten gallon fuel tank.

The burners used are the regular Improved Mohawk Burner with removable coil and patented non-clogging tip.

New Gas Filter Easily Installed

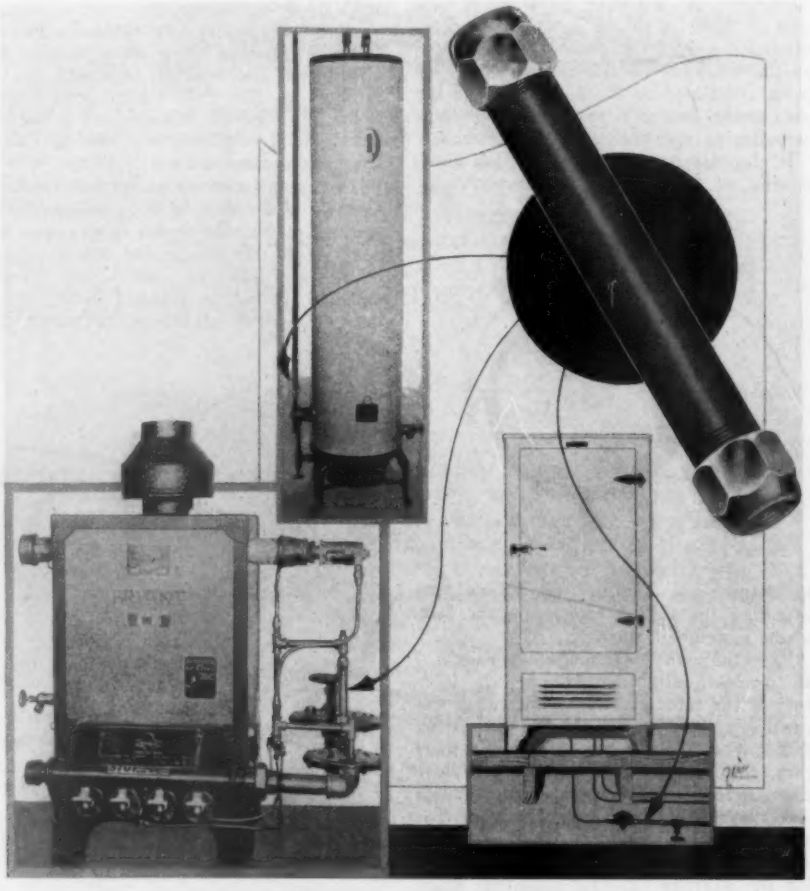
The Hugo Manufacturing Company, Duluth, Minn., announces a gas filter to guard such low consumption units as pilot lights, gas refrigerators, small burners, etc., called the Hawks Gas Filter.

It keeps all foreign matter from getting into important orifices or clogging adjustments, thereby insuring a steady burning flame.

A heavy filter paper folded inside a section of tubing, equipped with brass connections, strains the flowing gas of all scale or other matter, and yet allows the passage of 60 feet of gas an hour. As the average pilot light or low consumption burner burns from two to ten feet an hour, the maximum capacity of 60 feet assures a large margin of safety.

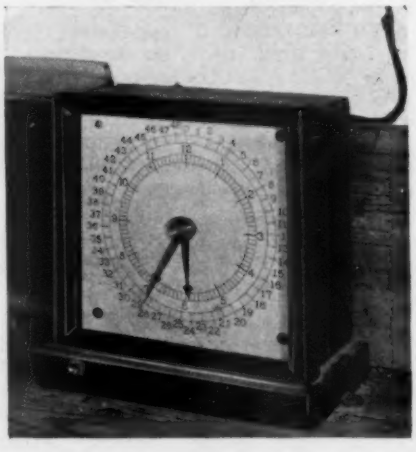
The filter is so constructed as to make it possible to replace the filtering element should this become necessary.

It is an easy job to attach the filter, either to equipment already installed or on new installations. It is merely a matter of placing it on the pipeline ahead of all adjustments, as easily done as putting on another section of pipe, as can be seen by the accompanying illustration.



Third Level Indicator

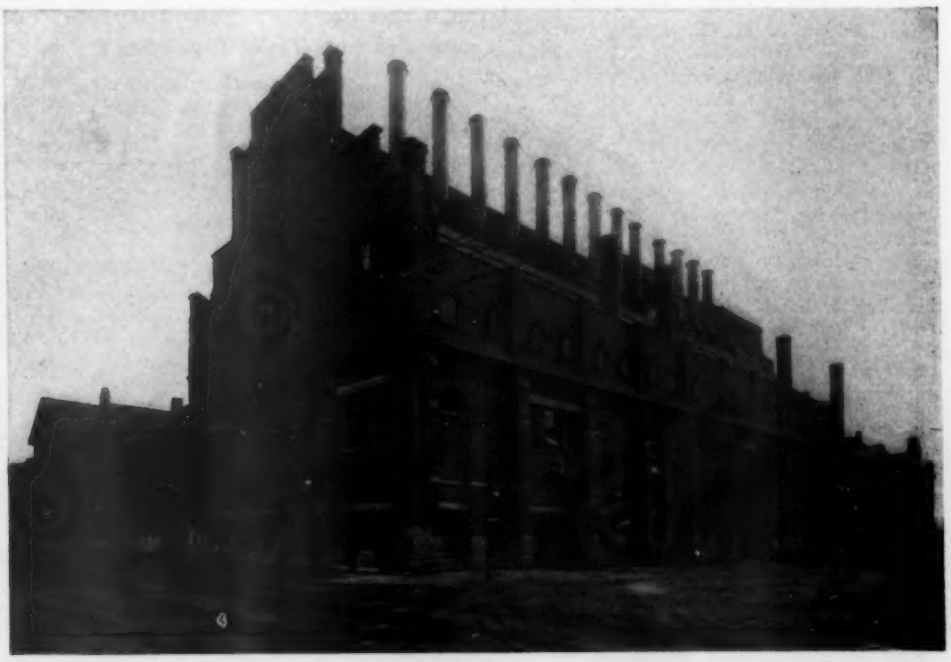
J. H. Bunnel & Company, Inc., 215 Fulton Street, New York, recently issued a bulletin illustrating and describing the MacCreedy Fluid Level Indicator. It is a simple, scientific, remote control gauge which automatically indicates the fluid level of storage tanks within an accuracy of 1/8 inch, producing continuous readings at one or more points at all times. The transmitter is connected directly to a specially designed float system and then electrically connected with one or more indicators located wherever desired. When the floats move 1/8 of an inch, the transmitter sends an electrical impulse to the indicator, whose dial at all times indicates the level of the fluid in the tank. It is battery operated.



GLOVER-WEST
VERTICAL RETORTS

Other Glover-West Installations

Fitchburg, Mass.
Springfield, Mass.
Portland, Maine
Ottawa, Ont.
Vancouver, B. C.
Victoria, B. C.
Watertown, N. Y.
Malden, Mass.
Fargo, N. D.
Toronto, Ont.
Guelph, Ont.
Santos, S. America
Pernambuco, S. Amer.
Buenos Aires, S. Amer.
Fall River, Mass.
Faribault, Minn.
Halifax, N. S.
Bellevilie, Ont.
Rio de Janeiro, S. America



AT TORONTO the third Glover-West Installation Is Now Operating

Three installations at Toronto—made in 1925, 1926 and 1930, respectively—tell the story of Glover-West Vertical Retort efficiency in the low cost production of gas that is constant in quantity and uniform in quality. The present daily capacity is twice that formerly obtained on the same ground area. Four waste heat boilers supply the entire works with steam at no extra cost.

West Gas Improvement Company

Builders of Coal Gas Plants

441 Lexington Avenue **New York, N. Y.**

NEWS OF THE GAS INDUSTRY

Wayne United Gas New Pipeline Complete

The new pipeline of Wayne United Gas Company, extending from the Morgan County, Ky., natural gas field, to West Liberty, Ky., has been completed and is now in operation, according to announcement of H. E. Danner, vice president of Appalachian Gas Corporation, the parent company. The company's new Morgan County compressor station also has been completed.

The output of eighteen wells is now being delivered through the new pipeline to Kentucky West Virginia Gas Company, for transmission to Louisville, Ky., under sales contract signed recently which calls for delivery of 2,000,000 cubic feet of natural gas per day this Winter, and 5,000,000 cubic feet daily next Winter.

Reduce Gas Rates

Gas rates charged by the municipal plant at La Grange, Ga., have been reduced 10 per cent by the action of the LaGrange city council.

The new rates, effective as of March 1 for bills rendered in April, will be $1.60 per thousand cubic feet for the first 5,000 feet, and $1.45 per thousand for all gas used above that amount. The old rate was $1.80 per 1,000 cubic feet for gas used under 5,000 and $1.62 per thousand for more than 5,000 cubic feet.

Slot meters, which operate with silver quarters, will be adjusted for the change as soon as possible, and until the adjustments can be made, users will be rebated the estimated difference.

File Articles of Incorporation

Articles of incorporation have been filed with the secretary of state of Indiana by the Lake Gas Corporation, having a principal place of business at East Chicago, Ind. The Corporation has an initial capital stock of 800 shares preferred and 2,200 shares of common, all without declared par value and is formed to deal in gas, coke and coal products. The first board of directors is composed of George L. Schein, Ernest Schein and Leslie G. Donahue.

Authorize Bond Issue

The Indiana public service commission has authorized the Citizens Gas Company of this city to issue $33,000 in bonds. The bonds are first consolidated mortgage 5 per cent gold bonds of the Indianapolis Gas Company and are to be sold at not less than 90 of par.

Appalachian Gas Corp. Subsidiary Completes New Texas Pipeline

Another link in Texas Gas Utilities Company's net work of natural gas pipelines serving cities and towns in South-West Texas has been completed and is now in operation, according to announcement of Ross Holmes, chief engineer of Appalachian Gas Corporation, the parent company. The new line, which traverses part of the rapidly-growing Winter Garden District of Texas, taps the company's main pipeline about twenty-five miles south of Uvalde, terminating in La Pryor, where a distributing system has been constructed to supply industrial, commercial and domestic customers. Gas for the line is supplied from the company's Uvalde field wells.

Appalachian Gas Corporation Developing Kentucky Field

Further developments of the Morgan County, Kentucky, natural gas field holdings of Wayne United Gas Company, subsidiary of Appalachian Gas Corporation, is indicated by announcement made recently by H. E. Danner, vice president of the corporation, that seven new wells are being drilled, which are scheduled for completion in the near future. The new wells will bring the total number owned by the subsidiary to 65.

Wayne United Gas Company recently completed a new compressor station at Grassy Creek and a new pipeline extending to West Liberty, Ky., to which the new wells will be connected to supply gas on a large new sales contract recently negotiated.

Smaller Communities on Pacific Coast Get Gas Service

Gas service on the Pacific Coast is rapidly expanding to the smaller communities, through the development of air butane or Bu-gas plants by the Natural Gas Corporation of California and affiliated companies—Natural Gas Corporation of Oregon and Natural Gas Corporation of Washington.

The latest community to receive this service is Dunsmuir, located near the Northern border line of California. This is a thriving little railroad center, the northern division point for the Southern Pacific Company, and the bringing of gas to this city by Natural Gas Corporation of California has met with a great deal of enthusiasm by both domestic and commercial consumers.

An exceptionally large number of appliances were purchased and installed, ready for adjustment the day the gas was turned on, and four crews were kept busy during the entire week. It is anticipated there will be more than 500 consumers by the end of the first year, which will be a very excellent record due to the fact that Dunsmuir has a population of only slightly in excess of 2600 residents.

The bringing of the comfort and convenience of gas to such communities as Dunsmuir and the various other similar towns on the Pacific Coast has only been possible through the development of air-butane or Bu-gas plants, which bring the cost of construction to such a figure as makes this service profitable in these communities.

Work Started on Natural Gas Pipe Line

The natural gas pipe line of the North Central Gas Company which will convey gas from the Muskrat field in Wyoming, located seventy five miles west of Casper, to various cities in eastern Wyoming and western Nebraska, and to cost about $6,000,000 is under construction.

The line of pipe will start with fourteen inches diameter and taper down to ten and eight inches, about 55 million cubic feet daily will be the peak. Some of the Nebraska cities that have signed for gas are: Alliance, Bavard, Bridgeport, Chadron, Crawford, Gering, Hemingford, Henry, Lyman, Mitchell, Morill, Minature, Rushville and Scotts Bluffs. Many more nearby are practically assured and then there are many industries along the route which will use the gas for fuel.

Propose New Schedule of Rates

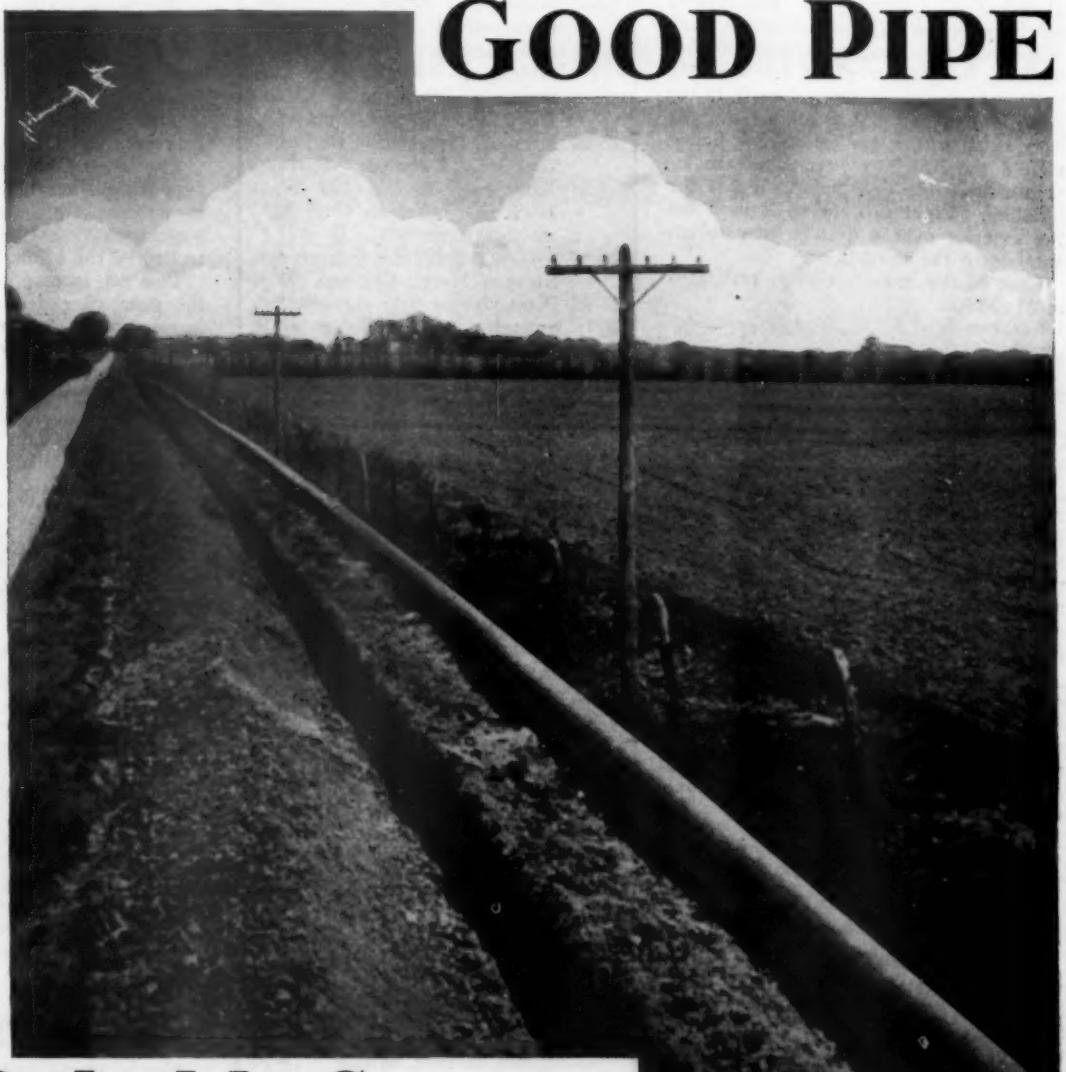
A new schedule of gas rates has been asked for Columbus, Ga. by the Gas Light Company of Columbus, following the introduction of natural gas in that city.

The rates, which are considerably lower than those formerly in force for small consumers, are: For the first 2,500 cubic feet, $1.35 per 1000 cubic feet per month. For the second 2,500 cubic feet, $1.00 per 1000 cubic feet per month. While a service charge of $1.00 per meter is asked.

The company asks that the new schedule of rates be put in effect on or after May 1, 1931, at which time transfer from artificial to natural gas will be completed.

(News continued on page 78)

The First Requisite . . . . . GOOD PIPE



For Reliable Service

Continuous and unvarying service to patrons is the essence of what a gas company sells. An uncertain or irregular service would be a service of limited value.

Because they appreciate this fully, and because they realize that durable, sound pipe is the first requisite for reliable service, many leading gas companies in all parts of the United States have made NATIONAL their standard.

Strength adequate for high pressures, unusual ductility, and excellent working quality in all respects, are among the merits that commend NATIONAL Pipe to informed users and are factors that have made it—

America's Standard Wrought Pipe

NATIONAL TUBE COMPANY, PITTSBURGH, PA.

Subsidiary of United States Steel Corporation

NATIONAL PIPE

Dallas Gas Building Progressing

Construction on the new thirteen-story office building under way for the Dallas Gas Company is progressing nicely, with the major construction work more than fifty per cent completed. According to present plans the building will be ready for occupancy early in the fall. The structure will have a foundation suitable for six additional floors, should the company ever decide to increase the present planned height of the building. Light face brick is used for the exterior over a granite base which extends to the third floor.

Cost of the construction is estimated at $1,250,000.

Amarillo Seeking Bids on Gas System

The city of Amarillo, Tex., will soon receive bids for pipes and fittings for 246 miles of gas mains which will comprise Amarillo's new municipal gas system, the commission has announced. Although the engineering department had not completed its estimated cost, it is reported that the investment will be in the neighborhood of a million dollars.

This is the first time such action has ever been taken by a city in Texas to finance a gas utility. The project was started when an agreement over gas rates could not be reached with the Amarillo Gas Company, local distributors.

Grant Petition to Transfer Franchise

The New York Public Service Commission has granted the petition of the Shore Gas Company to transfer its franchise, works and system in a portion of the town of Aurora, Erie County, to the Erie County Gas Company, Incorporated. The Shore Gas company is principally engaged in developing natural gas lands and the purpose of the transfer is to divorce the distributing business and to set it up as a separate operating company. The system consists of about four miles of distribution lines servicing 75 domestic consumers and two brick manufacturing plants. It is to be transferred at actual cost, said to be $19,647.53.

Pays Dividend for Thirty Years

Regular dividend disbursement, at the rate of $1.50 per annum, was declared for quarter ending March 31st, payable April 30th, at the monthly meeting of the Montreal Light Heat & Power Consolidated directorate held March 16th.

To avoid fractional payments the dividend is paid at 37c and 38c alternately each quarter, the current dividend being at the 37c rate.

It is noteworthy that this is the 120th consecutive payment to shareholders since the incorporation of the original Montreal Light Heat & Power Company in 1901.

Convention Calendar

April

13-15 Mid-West Gas Association, twenty-sixth annual convention, Julien Dubuque Hotel, Dubuque, Iowa. Joe Carmichael, 310 Crocker Bldg., Des Moines, Iowa, Director.

16-18 Missouri Association of Public Utilities, Excelsior Springs, Mo. Jesse Blythe, 103 West High St., Jefferson City, Mo., assistant secretary.

23-24 A.G.A. Accounting Conference, Stevens Hotel, Chicago, Ill.

28-30 Pennsylvania Gas Association, annual meeting, Galen Hall, Wernersville, Pa. Frank W. Lesley, secretary, 127 W. Market St., York, Pa.

May

1- 2 American Gas Association executive conference, Atlantic City, New Jersey.

11-14 Natural Gas Department, A.G.A., Peabody Hotel, Memphis, Tenn.

20-22 American Gas Association Production and Chemical Conference, Philadelphia, Pa.

June

2- 4 Institution of Gas Engineers, London, England, first international gas conference. J. R. L. Alexander, secretary.

4- 5 Canadian Gas Association convention, 24th annual meeting, Windsor Hotel, Montreal, Quebec, Canada.

9-11 Southern Gas Association, Chattanooga, Tenn. G. H. Schlatter, Birmingham, Ala., secretary.

15-20 Domestic Appliance Course, A. G. A. Laboratory, Cleveland, Ohio.

22-27 American Home Economics Association, Book-Cadillac Hotel, Detroit, Mich.

26-27 New England Gas Association, summer sales conference, Hotel Griswold, Eastern Point, New London, Conn.

29-July 1 Michigan Gas Association, annual convention, Mackinac Island, Mich. A. G. Schroeder, secretary-treasurer.

September

(First week) Pacific Coast Gas Association convention, San Francisco, Calif.

October

12-16 American Gas Association, Atlantic City, N. J. Alexander Forward, 420 Lexington Ave., N. Y. C., managing director.

November

16-21 Third Annual Conference on Bituminous Coal, Pittsburgh, Pa.

Annual Report Shows Decrease in Operating Revenue

Operating revenue of the West Ohio Gas Company for the year ended December 31, 1930, was $725,287.69 compared with $747,796.60 in 1929, a decrease of 3.01 per cent, according to the annual report of the company made public recently.

The West Ohio Gas Company, which supplies gas service to ten communities in western Ohio having an aggregate population in excess of 72,000, is controlled by the Midland United Company.

The net income of the company for the year after deducting operating expenses, taxes, interest on funded debt and other charges totaled $105,139.59.

The company in 1930 carried on an expansive construction program, laying 48 miles of gas transmission pipe lines and extending service to four additional communities.

Cities Service Net Earnings Increase 15%

Cities Service Company's net earnings for the twelve months ended February 28, 1931, increased 15.71% to $54,791,965 as compared with $47,350,465 for the like period ended February 28, 1930.

The average monthly increase in common stockholders has been 8,000 for the six months ended February 15, 1931. This figure jumped to 10,884 for the 30-day period ended March 14. Common stockholders of Cities Service Company now exceed 450,000.

Gross earnings increased from $48,790,728 for the year ended February 28, 1930, to $57,435,422, or a gain of 17.71%. Interest and discount on debentures were earned 5.38 times.

Net to stocks and reserves rose from $40,109,641 to $44,626,143, or an increase of 11.26%. Dividends on preferred stocks were earned 6.06 times as against 5.74 times in the preceding year.

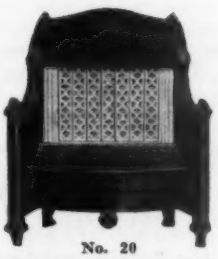
Net to common stock and reserve increased 12.49% to $37,264,593, as compared with $33,124,576 for a similar period ended February 28, 1930.

Gross and net earnings for the month of February were $3,469,531 and $3,259,498, respectively, compared with $5,180,001 and $5,021,357 for February, 1930.

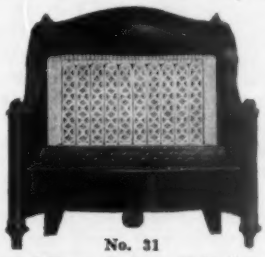
Coincident with the publication of its earnings statement, Cities Service Company announced monthly dividends of 2½ cents per share in cash and ½ of 1% in stock on the Common stock. Regular monthly dividends of 50 cents per share on the Preferred stock and Preference BB stock and 5 cents per share on the Preference B stock were announced, all payable May 1 to stockholders of record April 15.

(*News continued on page 80*)

Beauty *plus* Efficiency



No. 20
Vented Room Heater, 7 Radiants. Finished in black enamel, maroon, walnut brown, or green with brass trimmings. Provided with 3 in. vent.



No. 31
Vented Room Heater. 10 Radiants. Finished in black enamel, maroon, walnut brown, or green with brass trimmings. Provided with 4 in. vent.

No. 335
Vented Model. 10 Radiants. Finished in shaded brass. Provided with 4 in. vent.

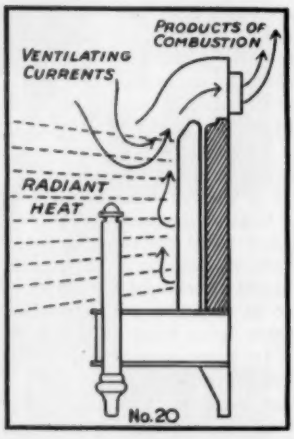
No. 33
Vented Commercial Fire. 10 Radiants. Finished in black enamel with nickel trimmings. Provided with 4 in. vent.

your assurance of a continuous volume of radiant heater business • •

CHILLY mornings -- damp days. That's when demand increases for instantaneous auxiliary gas heat. These attractive Humphrey Radiantfire portable models present excellent sales possibilities. A sales drive at this time will prove both timely and profitable. We will be glad to cooperate -- write for the new illustrated catalog and complete details.

A Portable Room Heater That is Really Vented . . .

The Humphrey Radiantfire can be equipped to burn either manufactured or natural gas. Note how positively the products of combustion are carried off by means of a properly designed vent hood. There are many convenient portable designs to harmonize with any home furnishings.



General Gas Light Company
Kalamazoo, Michigan

44 WEST BROADWAY
NEW YORK CITY, N. Y.

A HUMPHREY PRODUCT

135 BLUXOME STREET
SAN FRANCISCO, CALIF.

An Additional "Profit" • Customer Satisfaction

Humphrey Radiantfires are built to a high standard of quality in construction. Inexpensive operation and improved performance maintains good will years after the unit is sold. Radiantfire dependability helps you in your desire to sell appliances that will protect the health and comfort of your customers.

The HUMPHREY Radiantfire

Brooklyn Union Has Fine Exhibit at Food Show

The important role played by gas in the city's life was emphasized in a large number of displays at Brooklyn's 40th Annual Food Show which attracted thousands of visitors during the two weeks it was held.

How gas eases housework and contributes to the comfort of the modern home was depicted in an attractive display of The Brookyln Union Gas Company which occupied five booths.

In this space were exhibited a number of gas-fired appliances which served to illustrate the many uses of gas in the home.

By far the most interesting part of the gas company's display was the initial showing of the all gas "Kitchen Kompact" units which occupied the center of the exhibit.

These Kitchen Kompacts contain all the appliances and labor-saving appurtenances of a modern kitchen built into one unit.

One of the units is built to sell as one piece while the other is designed so that various parts may be purchased at different times and yet be pieced together so as to make a unified whole when all parts have been obtained.

In other booths at the show were exhibited many of the food products in the manufacture and preparation of which gas plays an important part.

The large baking companies, which use 547,000,000 cubic feet of gas annually, and the coffee industry, which uses 200,000,000 cubic feet in roasting the beans, were represented by leading concerns in both fields. Four of the largest bakeries on The Brooklyn Union Gas Company's lines, the General Baking Co., Continental Baking Co., Ward Baking Co. and Purity Baking Co., which alone use 190,000,000 cubic feet annually were among the exhibitors.

Until very recently few people were aware of the fact, but Brooklyn is the coffee roasting center of the world. The beans may be grown in Brazil or Colombia—thousands of miles away—but they are brought to Brooklyn to be roasted, cut and packed for shipment to all parts of the United States. Two of the larger companies using Brooklyn Union gas, the Maxwell House Products Co. and Albert Ehlers' Co., had attractive booths at the show.

Columbia University Offers Course in Household Appliances

Courses on household appliances will be held at Columbia University, New York in its summer session from July 6th to 24th. Some of the topics covered will be household gas ranges, gas range oven heat controls, expansion and contraction in household appliances, heat measurement, ice refrigerators, electric refrigerators, gas refrigerators, automatic gas water heaters, etc. Laboratory work can also be included with aforementioned course.

Complete Summer Session Bulletin of Information describing this work in detail and including information regarding requirements for degrees, credits, living accommodations, tuition and other matters of interest to prospective students, may be had without charge on application to the Secretary of Columbia University, New York City.

Memphis Natural Gas Reelects Board

The retiring board of directors of Memphis Natural Gas Company was reelected at the anual meeting. They are H. C. Abell, M. S. Binswanger, Henry D. Boening, George W. Carman, B. L. Johnson, H. G. Scott and O. H. Simonds.

A.G.A. Laboratory Course in Domestic Gas Appliances

A tentative program has been announced of the course in domestic gas appliances to be held at the A.G.A. Laboratory, Cleveland, Ohio, June 15th to 20th. Such subjects as gas ranges, their design and operation, gas range thermostats, gas refrigeration, water heaters, space heaters, practical work in the adjustment and use of gas appliances, clothes dryers, incineration by gas, chimney conditions, etc. will be covered.

"Application of Heat to Various Foods in Baking" will be the subject of a talk by Miss Dorothy Shank, Director Research Kitchen, American Stove Company. R. M. Conner, Director of the Laboratory will talk on "The Home Service Workers Place in the Industry." "Central Heating and Cooling for the Home" will be discussed by Major W. E. Stark, Research Engineer, Bryant Heater & Manufacturing Co. Miss Jessie McQueen, A. G. A. Home Service Counsellor will talk on "The Business of Home Service" and Miss Karen Fladoes, Chairman of Home Service Committee and Home Service Director, Equitable Gas Co., Pittsburgh, will give "A Comparison of the Relative Costs of Gas and Electricity."

Milwaukee Gas Co. Report Good

According to the annual report of the Milwaukee Gas Light Co., issued recently, the earnings of the company held up well during 1930, showing a net income of $1,569,892, as compared with $1,642,441 in 1929. The net income is after interest on funded debt, miscellaneous interest, amortization of debt discount and expense, and miscellaneous deductions have been made.

The total operating revenue came to $6,300,559, as against $6,345,638 the previous year. Total operating expenses were $2,879,404 and taxes $827,980. Total assets at the end of the year stood at $29,066,948, compared with $26,974,356 in 1929. Property and plant amounted to $26,088,899, while a year previous this item was $23,784,162.

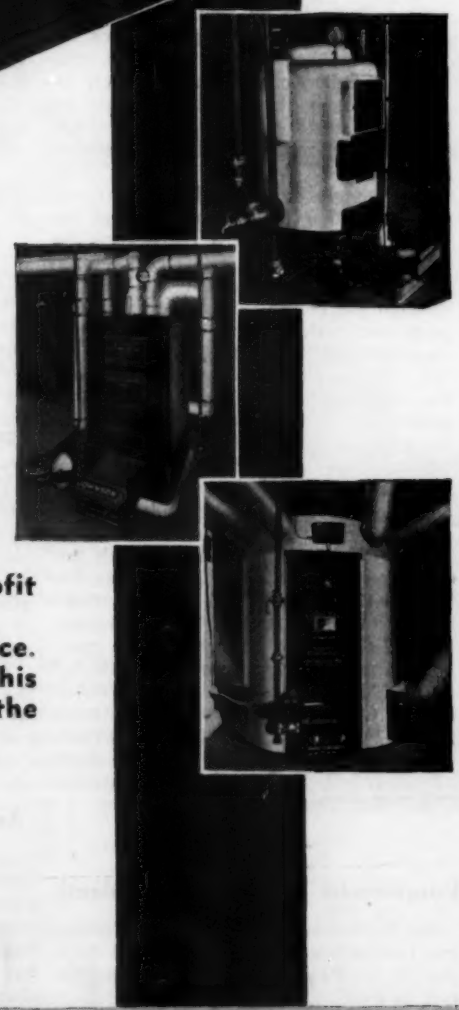
Appalachian Gas Corp. Extends Texas Pipeline System

Further extension of its pipe line system in the rapidly-growing Winter Garden district of Texas has commenced with the work of laying another new lateral line, through which La Pryor will be served with natural gas, according to announcement by officials of Texas Gas Utilities Company, wholly-owned subsidiary of Appalachian Gas Corporation. Work was simultaneously commenced on the construction of a distribution system for the supply of domestic, commercial and industrial consumers.

(*News continued on page 82*)

SAFE AND DEPENDABLE

JOHNSON
Automatic Gas Burner For Home Heating



WHAT A JOY TO LIVE IN A GAS HEATED HOME!

The installation of the perfected Johnson Gas Burner for home heating, brings undreamed-of comforts. When the story is properly presented to folks within your service area, the advantages and benefits of gas-heating become plainly apparent . . . and sales are the result! The transaction becomes mutually profitable. The buyer enjoys comfort and economy. You enjoy profit through the increased load.

The Johnson Automatic Gas Burner is a perfected appliance. Engineering skill and manufacturing efficiency give this burner a character which will re-act to your credit from the standpoints of profit and goodwill.

Johnson Burners are made in a range of sizes to fit any size or style of heating plant.

JOHNSON GAS APPLIANCE Co.
Cedar Rapids IOWA

GAS IS THE BEST FUEL

Southwestern Gas Measurement Short Course Shows Rapid Growth

The eighth annual Southwestern Gas Measurement Short Course will be held April 21, 22 and 23 at the University of Oklahoma, Norman, Okla. Conducted by the University's School of Engineering, the Short Course is sponsored by the American Gas Association, the Natural Gasoline Association, the Oklahoma Utilities Association, Oklahoma Corporation Commission and prominent equipment manufacturers.

From 60 at the first meter school to 450 at the seventh, attendance has steadily increased, indicating the growing importance of this phase of practical education for gas men and the interest shown by measurement men from all parts of the country. At last year's school representatives from 20 states and 2 foreign countries were present and the average attendance in classes was 95 per cent of the number of men registered.

The school is conducted as a combination of a few general meetings with technical papers and discussions, and a large number of small classes on particular subjects led by men experienced in the industry, where the personal experiences of everyone in the group are compared. Other classes are held on individual pieces of equipment and are led by special factory service men furnished by equipment companies having exhibits at the school.

Any person interested in measurement and regulation of gas may attend the course on payment of a registration fee of $3, which includes a ticket to the annual banquet. Arrangements can be made through the House Committee for rooms in private residences in Norman so that expenses may be kept to a minimum.

C. B. Day, Consolidated Gas Utilities Co., Blackwell Co., Blackwell, Okla., is chairman of the general committee in charge of arrangements. W. H. Carson, professor of mechanical engineering at the Oklahoma University, is active director of the short course and chairman of the banquet and entertainment committee. Other committee chairmen are as follows: B. L. Maulsby, Oklahoma Natural Gas Corp., Tulsa, program committee; W. R. McLaughlin, Arkansas Natural Gas Corp., Shreveport, La., committee for the study of practical methods; E. F. McKay, Oklahoma Utilities Association, Oklahoma City, registration committee; E. W. Rowland, The Empire companies, Bartlesville, Okla., publicity committee, and E. E. Stovall, Lone Star Gas Co., Dallas, Texas, exhibit committee.

Commercial Meeting in Portland

On Wednesday, March 25th, the Northern Conference of the Commercial Section of the Pacific Coast Gas Association met in Portland, Oregon.

There were meetings in the forenoon and afternoon in the auditorium of the Portland Gas & Coke Company, Public Service Building. A dinner meeting was held in the evening at the Benson Hotel, at which F. U. Naylor, Manager of Gas Sales Pacific Gas & Electric Company, San Francisco, was the principal speaker.

This conference differed from previous conferences, in that there were no papers prepared; each one on the program had a certain subject alloted to him, which he led in discussion.

The following were on the program: J. Earl Jones, Commercial Manager of Seattle Gas Company, who spoke on "Trends in the Domestic Market for Gas"; F. U. Naylor of San Francisco, on "Methods employed and results attained in acquiring business in New Territory"; R. W. Coblentz, Sales Manager of the Washington Gas & Electric Company, Tacoma, Wash., on "Merchandising Campaigns—Their Planning and Results"; C. R. Miller, Chairman, Industrial Sales Committee of the Pacific Coast Gas Association and Superintendent of Utilization of the Portland Gas & Coke Company, on "Plans for Interchange of Commercial and Industrial Sales Data"; Clifford Johnstone, Managing Director of the Pacific Coast Gas Association, San Francisco, on "Coastwide Sales Situation."

Mr. John H. Hartog, who is Sales Manager of the Portland Gas & Coke Company, acted as General Chairman of the morning and afternoon meetings, as well as Toastmaster at the evening meeting.

Quarter Century Club Meets

Two hundred and forty members of the Philadelphia Gas Works Company Quarter Century Club attended the first annual meeting and dinner of the club recently at the Benjamin Franklin Hotel. W. H. Gartley, vice president of the company, who is a member of the club with more than 41 years of service, presided at the meeting.

Eighteen men who had passed the 25-year service mark during the past year were presented with certificates of membership by Conrad N. Lauer, president of the gas company. Mr. Lauer congratulated the members on their length of service in the operation of the city-owned gas works.

Length of service of the members of the club ranges from 25 to more than 50 years.

Articles of Incorporation Filed

Articles of incorporation have been filed with the secretary of state of Indiana by the Marion County Gas Corporation having a principal place of business in Indianapolis. The corporation has an initial capital stock of 10,000 shares having no declared par value and is formed to operate gas works, plants, mains, etc. The first board of directors is composed of Barbara Eifert, Raymond L. Walker and Frederick Van Nuys.

Permission Granted to Extend Distribution System

The New York State Commission has granted the petition from the Republic Light, Heat & Power Company to construct an extension of its gas distribution system in a portion of the towns of York and Avon, Livingston County, and to connect the company's Pavillion field in Genessee County with its Ontario District field in Ontario County in order to provide a more adequate supply of gas in the towns of Lima, East Bloomfield, West Bloomfield and Bristol. The line will be a 4-inch steel line about 22 miles long. The estimated cost is $94,151. The proposed transmission line will be connected with the mixed gas supply which comes from a plant near Niagara Falls and assures a desirable supply of gas from this source in case the supply of natural gas should prove insufficient.

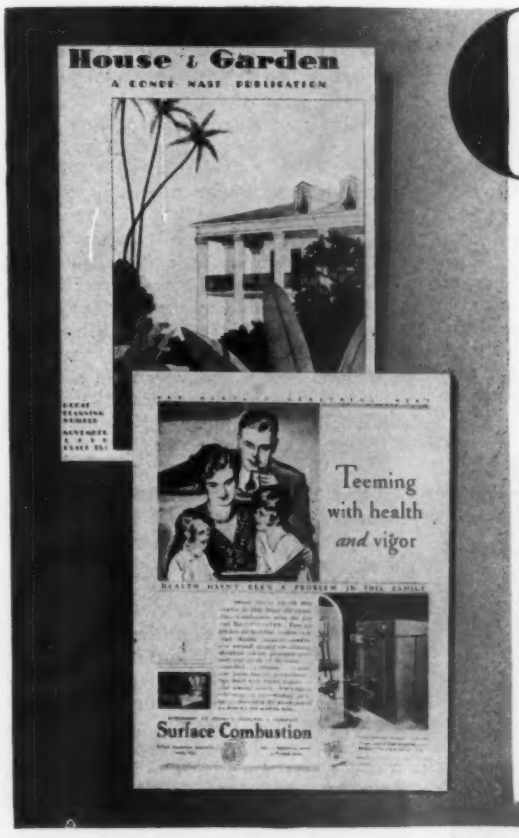
BOOK REVIEW

Steam Decomposition in Water-Gas Making

An investigation of the Manufacture of Water Gas with Especial Reference to the Decomposition of Steam, by Lloyd Logan. Published in mimeographed form by Department of Gas Engineering, The Johns Hopkins University, Baltimore, 1929.

This thesis represents one of the outstanding recent contributions made at an institution where gas engineering is recognized as a distinct division of the engineering profession and accorded an opportunity for effective development through adequate curriculum and faculty support. It is an evidence that the gas industry will gain a great deal for its own advancement from the support of fundamental education in the theory as well as in the practice of gas making. Both the author and professor Wilbert J. Huff are to be congratulated on the contribution.

It is not practical in a brief review to bring out anything of the important significance of the thermo-dynamic and experimental study which has been executed. It must suffice here to say that every engineer who presumes a knowledge of the underlying theory of water-gas making should procure a copy of this thesis and make a careful study of the application of the results presented to his own plant operations. That these results are of practical value need not be questioned. Much of the plant-scale experimental work had the active cooperation of Mr. John H. Wolfe, superintendent of manufacture for Consolidated Gas Electric Light and Power Company of Baltimore. That in itself is evidence of the practical usefulness as well as the sound approach which has been made in the large-scale work.



OUR CONTRIBUTION FOR BUILDING....

CONSUMER ACCEPTANCE

OF RESIDENCE HEATING WITH GAS

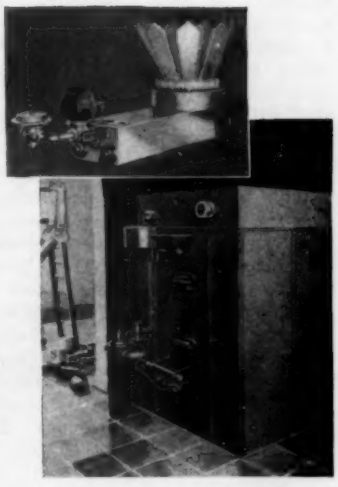
STARTING IN THE MARCH ISSUE OF

House & Garden

House & Garden Magazine has been selected by Surface Combustion as a means of visualizing to home owners and architects the health-building qualities of circulating warm air and the convenience of GAS-HEAT.

Attractive full page advertisements carrying a carefully planned message will reach 125,000 interested home owners. The advertisements feature the Columbus HEATMASTER, the story of REVITALIZED air and GAS-HEAT as the modern, healthful method of heating residences.

Inquiries and prospects stimulated by this campaign will be referred to the local Gas Company . . . reprints of advertisements and other merchandising material will be available to those wishing to tie up locally with the campaign. If you want more details we will gladly supply them.



House & Garden INFLUENCES
ARCHITECTS, TOO

It reaches 91% of the members of the American Institute of Architects.

Its advertising pages are used as a guide in selecting material and specifying equipment.

Publisher mails special supplement to 4000 Architects ten days in advance of publication date.

Surface Combustion

SURFACE COMBUSTION CORPORATION, TOLEDO, OHIO « » SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

PERSONALS

Everett B. Collins becomes operating manager of the Northern Group with direct responsibility for the following companies; Grafton County Electric Light & Power Company, Fall Mountain Electric Company, New England Power Corporation of Vermont, Hartford Water Company.

W. K. Morsman has been placed in charge of new business activities of the Nebraska Distributing Company, Falls City, Neb.

Grace Whitten, an employee of the Jersey City Commercial Office of the Public Service Corporation of New Jersey, was presented a McCarter Medal for having revived by the prone pressure method of resuscitation a man who was overcome by gas.

Dr. Leonard Harrision Cretcher has been appointed to an assistant directorship in the Mellon Institute.

Dr. Cretcher, who, since 1926, has been serving as head of the Institute's Department of Research in Pure Chemistry, is a specialist in organic chemistry and will have supervisory charge of a group of industrial fellowships that are concerned with problems in organo-chemical technology.

In addition to serving in this positional capacity, Dr. Cretcher will continue as directional head of the Department of Research in Pure Chemistry. In this work he will be aided by Dr. William L. Nelson, who has been made senior fellow in pure research. Beside Drs. Cretcher and Nelson, the departmental staff will include Drs. C. L. Butler and Alice G. Renfrew.

John West becomes operating manager of the Northeastern Group of the headquarters at Arlington, Mass., and with direct responsibility for the following companies: Arlington Gas Light Company, Lexington Gas Company, Woburn Gas Light Company, The Lowell Electric Light Corp., Lawrence Gas and Electric Co., Salem, N. H., Electric Light Company, Gloucester Gas Light Company, Amesbury Electric Light Co.

Guy K. Dustin becomes operating manager of the Western Division, New England Power Association with headquarters at Northampton, Massachusetts, and with direct responsibility for the following companies: Northampton Electric Lighting Company, Northampton Gas Light Company, Mill River Electric Light Company, Central Massachusetts Electric Company, Ware Electric Company, Palmer Gas Company, Southern Berkshire Power & Electric Company, Adams Gas Light Company, North Adams Gas Light Company, Williamstown Gas Company, Deerfield River Electric Company, Stamford (Vt.) Light, Heat and Power Company.

Allyn C. Taylor was elected president of the Consumers Gas Company, Reading, Pa., at a meeting of the board of directors recently, following the resignation of John Arthur Keppelman. Consumers Gas Company is a U. G. I. subsidiary.

Mr. Keppelman, who succeeded his father, the late John H. Keppelman, as president in August, 1924, also has resigned from the gas company board so that he may devote his time to his legal practice to the exclusion of all other activities.

Allyn C. Taylor

The joint service of Mr. Keppelman and his father in the management of the gas business in Reading has covered the entire period of its history, somewhat more than forty-five years, and the board expressed its regret that his other interests made it necessary for him to sever his connection with the company.

Mr. Taylor, who has been associated with the Consumers Company since 1922, has been in the gas business ever since his graduation from the Massachusetts Institute of Technology in 1906. His experience has been unusually broad in all phases of operation. He began as street clerk with the Philadelphia Gas Works, where he advanced to assistant district superintendent. In 1910 he went to Harrisburg as main and service foreman, and about a year later became superintendent of the gas department of the Charleston Consolidated Railway and Lighting Company, Charleston, S. C., and from 1913 to 1922 he was assistant engineer of the Allentown Gas Company and later engineer of the combined Allentown and Bethlehem properties. In Reading he has advanced to the head of the company through the positions of assistant manager, manager and vice president.

Roy F. Whitney becomes operating manager of the Southern Group of the New England Power Association properties, under the new plan of organization for the retail territory now served by companies owned, or controlled by, or operated under the supervision of the Association, which divides them into six major operating groups. Mr. Whitney will make his headquarters at Providence, Rhode Island, with direct responsibility for the following companies: The Narragansett Electric Company, South County Public Service Company, The Mystic Power Company, Fall River Electric Light Company, Attleboro Steam and Electric Company, Tiverton Electric Light Company, Seekonk Electric Company, Norton Power & Electric Company.

Leon E. Seekins becomes operating manager of the Central Division of the New England Power Association, with headquarters at Worcester, Massachusetts. He will have direct responsibility of the Worcester Electric Light Company, Webster and Southbridge Gas and Electric Company, Worcester Suburban Electric Company, The Blackstone Electric Light Company, Leominster Electric Light and Power Company, Leominster Gas Light Company, Clinton Gas Light Company, The Ayer Electric Light Company, Harvard Electric Company, Gardner Electric Light Co., Gardner Gas, Fuel and Light Company, Athol Gas and Electric Company, Winchendon Electric Light and Power Co., New Salem Electric Co., and The Spencer Gas Company.

George W. Perry has been appointed operating manager of the Southeastern Group of the New England Power Association properties and will have direct charge of the following companies: Quincy Electric Light and Power Co., Weymouth Light and Power Company, Weymouth Water Power Co., Randolph & Holbrook Power & Electric Co., Plymouth Electric Light Co., Plymouth Gas Light Co., Southeastern Massachusetts Power & Electric Co., Norwood Gas Co., Milford Gas Light Co., Milford Electric Light & Power Co., Marlborough Electric Co., Marlborough-Hudson Gas Co., The Westborough Gas and Electric Co., Union Light & Power Co., He will make his headquarters at Quincy, Mass.

W. Stanley Strong has been appointed Supervisor of Sales of the Northern Service Headquarters of the Public Service Company of Northern Illinois, Chicago. He succeeds F. B. Harris who is taking charge of the House Heating Division.

Lester Bernstein for a number of years Manager of the Commercial Department of the Philadelphia Company, Pittsburgh, Pa., resigned recently to become Vice President of the International Fibre and Chemical Corporation of Pittsburgh.

(*Personals continued on page 86*)

Service Calls

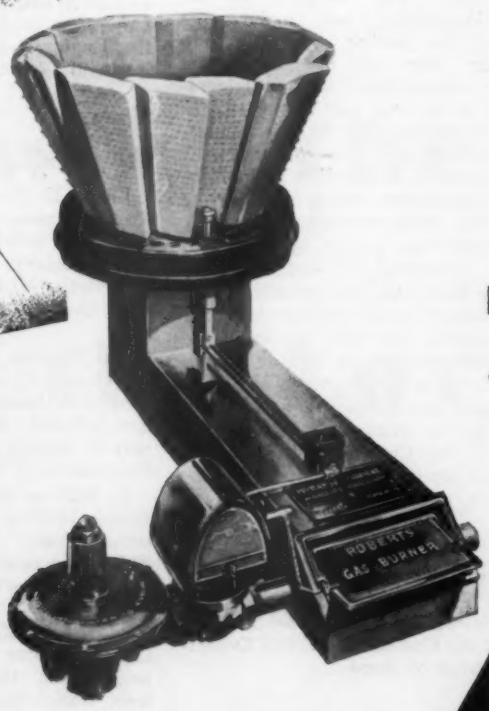
are rare with a Roberts

Simple construction
Carefree operation

Backed by
a merchandising plan
second to none in the
industry

Send for complete information!
No obligation

Heat YOUR HOME with Gas



ROBERTS-GORDON
APPLIANCE CORPORATION
CURTISS BLDG. BUFFALO, N. Y.

ROBERTS
CONTROLLED
GAS HEATING UNIT

Personals

(*Continued from page 84*)

W. E. Land succeeds L. E. Nichols as Gas Engineer of the Public Service Company of Northern Illinois at Ottawa. Mr. Nichols has been transferred to the General Office Operating Department.

J. J. Theobald, formerly Supervisor, Service Engineering Division of the Westchester Lighting Co., Mt. Vernon, New York, is now Commercial Engineer of that company.

H. D. Swain has been appointed manager of the Westchester Lighting Company's Peekskill Commercial District. Mr. Swain entered the employ of the old Peekskill Lighting and Railroad Company in 1903. He was elected treasurer of that company in 1908 and at the same time appointed assistant treasurer of the old Northern Westchetser Lighting Company. With the merger of the two northern companies into the Westchester Lighting Company in November, 1929, Mr. Swain was made statistician.

Loren Laughlin, former manager of the Kansas Pipe Line & Gas Company at Kinsley, was transferred to Abilene, Kansas, where he is local manager.

J. P. McLoughlin has been appointed Company Auditor of the Westchester Lighting Company, Mt. Vernon, N. Y.

Harry Goldsworthy has been transferred from the General Commercial Department of the Central Hudson Gas & Electric Company to the Kingston, N. Y. office where he is in charge of gas house heating sales.

F. J. Cottrill is now General Commercial Manager of the Wisconsin Power & Light Company at Madison.

D. L. Sedgwick has recently been appointed Chief Gas Engineer of the North American Light & Power Company, Chicago, Ill. Mr. Sedgwick has had wide experience in gas plant construction maintenance and operation.

A. W. Scofield has recently been appointed commercial manager of the Kansas Pipe Line & Gas Company at Great Bend, Kansas. He succeeds C. G. Hinthorn, who resigned to accept a position in Iowa.

Geo. Rodhouse has been placed in charge of the gas distribution systems of the Mississippi Power & Light Company properties in the Mexico district.

Idus Swearingen, former construction foreman for the Fort Worth Gas Co., is now in charge of all outside construction for the Council Bluffs, Iowa, Gas Co.

Carl Turner was recently made Sales Manager of the New London Division of the Connecticut Power Company.

W. M. Millett, General Manager and C. H. Kallstedt, General Sales Manager of the Western United Gas & Electric company, Aurora, Ill., were recently elected vice-presidents at a meeting of the Board of Directors.

E. L. Foster, district salesman of the Community Natural Gas Company Greenville, Texas, won an award of twenty-five dollars in gold for selling 62 gas ranges in a 30 day contest sponsored by the Detroit Michigan Company.

Jesse A. Pruett has accepted the post of Superintendent of Gas Production with the Honolulu Gas Company. Mr. Pruett was formerly connected with the San Diego Consolidated Gas & Electric Company, San Diego, Calif.

W. S. Walker has been named Assistant Engineer of Utilization of the Consolidated Gas Company of New York, according to a recent announcement made by Czar H. Fogg, Vice-president in charge of Commercial Relations. Mr. Walker will have charge of the Department, taking the position left vacant in January by the death of C. Y. McGown.

Mr. Walker joined the Consolidated Gas Company of New York as a cadet engineer shortly after graduation from the University of Virginia in 1926 with the degree of Mechanical Engineer. He was, in turn, assigned to the Manufacturing Department, the Distribution Department, the Construction Department and the Utilization Department. In the latter department he was engaged in industrial installation and maintenance work and in testing of appliances, the major part of the assignment being in connection with refrigeration, both in the field and in the laboratory. In September 1929, he was appointed Acting Assistant Superintendent of the Refrigeration Installation and Maintenance Department, which position he held until his recent promotion.

Mr. Walker has several inventions to his credit, including the water strainer adopted by Electrolux refrigerator, a new type of thermostat for refrigerators, the Ensign-Raynolds gas filter for small appliances and refrigerators, and the ensign-Reynolds bending and flaring tool.

Mr. Fogg's announcement also called attention to the creation of several new positions in the Customers' Service Department of the company and the promotion of six other Consolidated men as follows:

William C. Oeckler, formerly Superintendent of the Second Avenue Shop, has been made Assistant General Superintendent of the Customers' Service Department, in charge of shops.

C. C. Muehlberg, who has been Manager of the Industrial Division of the Sales Department, has been promoted to Assistant General Superintendent of the Customers' Service Department, in charge of Appliance Maintenance Divisions.

F. E. Vilas and A. V. Hay have been appointed, respectively, Superintendent of Domestic Appliance Maintenance Division and Superintendent of Commercial Appliance Maintenance Division. Mr. Vilas was formerly Acting Superintendent of the Refrigeration Installation and Maintenance Department, and Mr. Hay was contact engineer in the Industrial Inspection and Maintenance Division.

J. A. Malone has been promoted to Manager of the Industrial Division, and Paul Dorchester has been made Assistant Manager. Mr. Malone was formerly Assistant Manager, under Mr. Muehlberg, and Mr. Dorchester was a sales engineer in the Division.

George F. B. Owens has been appointed Domestic Sales Manager of the New Business Department of The Brooklyn Union Gas Co.

Obituary

WILEY J. HUDDLE

Wiley J. Huddle, 52 years old, a consulting engineer, with offices at 122 S. Michigan Ave., Chicago, died recently as the result of injuries suffered when he was struck by an automobile.

Mr. Huddle at one time had complete charge of the Chemical Engineering and Industrial Engineering Departments at the University of Oregon. He was also on the Engineering Staff of the Wisconsin Railroad Commission.

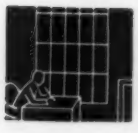
LLOYD E. ELDRIDGE

Lloyd E. Eldridge, vice-president and assistant general manager of Philfuels Company, subsidiary of Phillips Petroleum Company, died Saturday, March 14, in Detroit, Michigan. His untimely end, at 31, came as the result of a throat infection.

Mr. Eldridge, since his graduation from the University of Illinois in 1922, has become well known in the oil and natural gas industry, his first connection being that of chemist with Chestnut and Smith Corporation in Texas.

In 1923 he entered the employ of the Baltic Gasoline Company as assistant superintendent. From 1926 to 1928, Mr. Eldridge was associated with the Humble Oil & Refining Company as a refinery superintendent. On January 15, 1928 he was employed as office manager for Philfuels Company, later being transferred to Detroit, when the company headquarters were transferred to that city. Here he was promoted to the position of vice-president and assistant general manager.

He leaves his wife, Mary, daughter of Mr. and Mrs. David C. MacRae, of Ranger, Texas, and two children, ages five and two.

Less servicing, fewer complaints, greater satisfaction over a longer period of time  **just a few of the reasons why the Lovekin Gas Water Heater is a profitable heater to sell.**

TRADE NEWS

United Engineers & Constructors, Inc.—Activities

Contract has been awarded by Allentown-Bethlehem Gas Company, Allentown, Penna., to furnish, deliver and install approximately 11,000 feet of 4" welded steel main between Emaus and Vera Cruz, Penna., also contract to furnish, deliver and install 6400 feet of 6", 20,800 feet of 4" and 13,000 feet of 2" steel main between Emaus and Macungie, Penna.

Contract has been awarded by Consumers Gas Company, Reading, Penna., to furnish, deliver and install 9310 feet of 12" steel main with Dresser joints, in Reading, Penna., also contract to furnish, deliver and install 13,160 feet of 8" welded steel main and 416 feet of 2" galvanized steel screwed main between Womelsdorf and Stouchburg, Penna.

Contract has been awarded by the Allentown-Bethlehem Gas Company, Allentown, Penna., to furnish, deliver and install 21,700 feet of 8", 1000 feet of 4" and 2000 feet of 2" steel main between Allentown and Wesconsville. Penna.

Contract has been awarded by Philadelphia Electric Company, Phila., Pa., to furnish, deliver and install approximately 5200 feet of 20" steel main with Dresser joints from the Handling Plant at West Conshohocken, Pa., to the East side of Bridge across Schuylkill River.

Contract has been awarded by Jersey Central Power and Light Company, Asbury Park, N. J., to furnish, deliver and erect at Long Branch, N. J., one (1) 7'6" U. G. I. Vertical Waste Heat Boiler.

Contract has been awarded by The Connecticut Light & Power Company of Waterbury, Conn., to furnish, deliver and install at its works in Norwalk, Conn., 2 21'0" x16'4" purifier boxes, including foundations.

New Sales Connections for Link-Belt Limited

Mr. E. C. Burton, Vice President of Link-Belt Limited, Toronto, Montreal and Vancouver, announces the appointment of sales representatives in the prairie provinces.

In Manitoba and Saskatchewan, Link-Belt will be represented by Manitoba Bridge & Iron Works Ltd., of Winnipeg. The officials of this organization are: Messrs. H. B. Lyall, Vice President and General Manager; J. A. McCullouch his assistant; H. A. Mac Kay, Chief Engineer; and Mr. K. B. Schiller sales manager. Having sales offices in Calgary and Regina, and operating foundries, structural and machine shops, as well as rolling mills, this concern is in an excellent position to give efficient service in the territory they serve.

Riverside Iron Works Ltd., Calgary, will represent Link-Belt in Southern Alberta. They operate grey iron and steel foundries as well as structural and machine shops. Mr. F. L. Irving is the manager, Mr. R. H. Findlay is chief engineer and Mr. R. A. Millar sales manager.

Thermostat Sales Indicate Big Demand for New Gas Ranges

When a device is sold only with new gas ranges, its sales volume becomes a very good indicator of the general tone in the gas range market. The sales of Robertshaw AutomatiCooks have been mounting most consistently since the turn of the year, reaching carload proportions early in March.

The remodeling and modernizing movements which have received so much prominence all over the country are enabling energetic dealers to sell many new ranges, now that so many home owners are giving serious thought to making their homes truly modern in equipment as well as interior and exterior construction.

Natural Gas Equipment Corp. Issue New Catalog

To all those interested in automatic pressure regulation for gas, steam, liquids or vapors the new catalog just issued by the Natural Gas Equipment, Inc., of Los Angeles, will be of interest.

This new catalog contains new information and new equipment just developed, arranged in such a manner as to make it easy to find and use.

Reference material, blue-printed installation charts, as well as camera studies of unique installations are found within the covers of the 60-page book.

A copy will be gladly mailed to any interested operator if Natural Gas Equipment, Inc., Petroleum Securities Building, Los Angeles, is addressed.

New Catalog on Ash Conveyor System

United Conveyor Corporation, Chicago, Ill., announces a new catalog describing their Nuveyor Ash Conveyor System. This catalog outlines the principle of operation and field of application. It also contains illustrations of outstanding installations.

New Domestic Heat Control Company

A new corporation, to be known as the Penn Heat Control Company, in which the General Electric Company has a controlling interest has been formed to take over all assets, including patents and good will, of the Penn Heat Control Corporation, Philadelphia, specializing in apparatus for automatic regulation of temperature in household heating. The new company will continue and expand the work previously done by the Penn Heat Control Corporation.

Recent marked improvements in the automatic regulation of temperature and the steadily increasing demand for it lies back of the entrance of the General Electric Company into the field of domestic heat control. The replacement of hand-firing, whether in control of coal, oil or gas heating, by electrically operated methods of regulation is foreshadowed in much of the new apparatus now being manufactured. A wide range of General Electric products for use in the field will be developed and details concerning them will shortly be announced.

The new corporation will retain the personnel and organization of the Penn Heat Control Corporation as the basis for its operation.

Building Addition to Factory

The Hays Corporation of Michigan City, Indiana, has begun construction of a new steel and brick foundry building adjoining their present factory to provide an additional 6000 square feet of space for the manufacture of Hays Combustion Efficiency Instruments—CO_2 and Draft Recorders, Indicating and Recording Draft Gages, Flue Gas Analyzers, Portable Combustion Test Sets and complete Boiler Panels.

Joseph G. Pollard Co., Inc., Open Branch in Chicago

The Joseph G. Pollard Co., Inc., Brooklyn, N. Y., manufacturers of Pipe Line equipment for water and gas companies have opened a branch office and warehouse at 1749 West Lake St., Chicago, Ill. Mr. W. A. Start, for several years with the Neptune Meter Co., and later with the A. P. Smith Mfg. Co., covering the central west and southwestern states will have charge of the Chicago branch.

A complete stock of pipe line equipment will be carried at the Chicago warehouse, thereby facilitating prompt shipment in the territory west of Ohio.

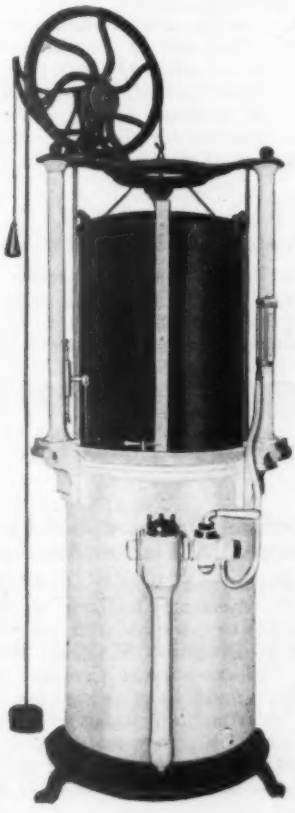
Chace Valve Co. Appoint European Agents

The W. M. Chace Valve Company of Detroit have recently appointed the Melchior, Armstrong, Dessau Company, 116 Broad Street, New York City as their European Sales Agents for Chace Thermostatic Bimetal, covering the British Isles and most all of the Continental Europe.

(*Trade News continued on page 90*)

SUPERIOR

Gas Meters
Provers
Service Cleaners
Diaphragms
Repairs



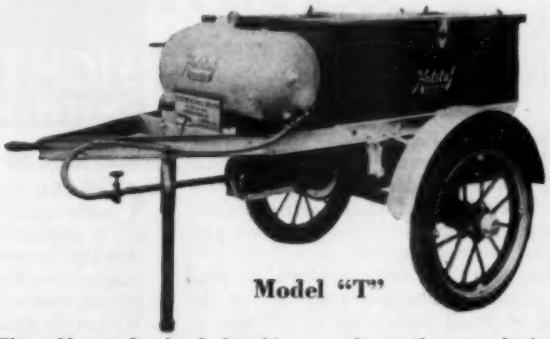
SUPERIOR METER CO.
167-41st Street
Brooklyn, N. Y.

ESPECIALLY DESIGNED

MOHAWK HI-SPEED TRAILER FOR Hotstuf

GAS COMPANIES PIPE LINE JOBS

All Mohawk Hi-Speed Tool Trailers have been designed in every detail with the aid of practical suggestions from men on the "firing line."
Compartments, trays and fastenings are built to hold every tool and supplies.
Made in 6, 7 and 8 foot lengths. Other sizes and special features made to your specifications.



Model "T"

The Hotstuf Asphalt Heater has the exclusive patented Elevated Melting Chamber Feature, and will deliver hot bitumen in fifteen minutes after lighting the torch, and will continue delivering it at a rate as high as 8,000 pounds in eight hours if you so desire it, with perfect temperature control.
Compare its melting capacity with other makes.

WRITE FOR CATALOGUE AND PRICES

MOHAWK ASPHALT HEATER CO., Schenectady, N. Y.

Trade News

(Continued from page 88)

Barber-Greene Representatives Meet

Fifty-five representatives of the Barber-Greene Company in the United States and Canada gathered at the company's plant at Aurora, Illinois, recently for the annual Barber-Greene Sales Conference.

The meeting took the form of an instruction course with class room lectures and laboratory work. In the class room the men were addressed by Mr. H. H. Barber and Mr. W. B. Greene, President and Vice President, and by other officers of the company, who outlined the policies and methods of the home plant. Guests of honor who addressed the assembly were Mr. J. W. O'Keefe, Secretary of the Chicago Association of Credit Men; Mr. H. J. Fauber, President of the Central West Engineers, Inc., of St. Louis, a company that has laid extensive pipe lines throughout Illinois, Indiana, and Missouri; and Mr. Mike Andrews, foreman second in charge of the concreting by conveyor of the Marshall Field Merchandise Mart, and more recently in charge of the same operations on the three million dollar American Can Company building in Chicago.

The laboratory work included a review of all the machines now produced by the Barber-Greene Company and many that will be introduced into their various fields in 1931.

D. McGeorge Joins Central West Coal Co.

Don McGeorge recently joined the Central West Lake Coal Company, Cleveland, Ohio, in selling and Lake inspection capacity. For some six years Mr. McGeorge has been very active in coal as engineering inspector at the mines of the J. P. Burton Coal Company and Lake and Mine inspector for the W. H. Warner and Company. His duties will also include the inspection of the Central West Coal Company's mines.

C-E Stoker Unit

Combustion Engineering Corporation, 200 Madison Avenue, New York, has recently issued a folder describing their new C-E Stoker Unit, which is a self-contained underfeed stoker with electric drive and integral fan construction.

This stoker has been developed to provide a simple automatic machine for the firing of small boilers up to 150 hp. It has a number of features not available in other machines of its size, such as, agitated grate bars, side dumping grates and agitated feed hopper which eliminates arching of the coal and interrupted feed.

The design is self-contained, completely enclosed and provides a simple rugged and dependable unit for the underfeeding of coal under small boilers. Three sizes are available with coal burning capacities of 300 lb., 600 lb. and 1000 lb. of coal per hour respectively.

Due to its unit construction, a C-E Stoker Unit may be installed and placed in operation in 6 to 12 hours.

The folder includes photographs and application drawing, a table of dimensions and capacities for the three sizes, and a discussion of the features of the stoker.

Bristol Co. Issue New Catalog

The Bristol Company, Waterbury, Conn., recently issued Catalog No. 4000, covering Bristol's Air Operated Controller Equipment, including Instrument, Valve and Accessories Sections. The equipment is fully described and illustrated and each section contains list prices.

American Radiator and Cochran-Sargent Affiliation Announced

Announcement is made of the affiliation of the American Radiator & Standard Sanitary Corporation with the Cochran-Sargent Company, St. Paul, Minnesota. The Cochran-Sargent Company will be operated under its present name as a division of American Radiator & Standard Sanitary Corporation and without change in either official personnel or policy.

LET US HELP YOU

CANCER in its early stages is usually curable when properly treated. If you have the slightest suspicion that you have cancer, consult a physician at once. The odds are against your having cancer, but why take a chance? Why wait until it may be too late? Follow the advice of your own doctor, or of your local Cancer Committee.

For free information write, call or telephone to

The New York City Cancer Committee

34 East 75th Street • RHinelander 4-0435

If not a resident of New York City—write to the **American Society for the Control of Cancer, New York, N. Y.**

Practical Salesmanship Texts

The Cleveland Heater Co., 1900 112th St., Cleveland, Ohio, have announced a series of 12 books, pocket-size, entitled "Practical Salesmanship" which have been prepared for the water heater salesman. The lectures in these books have to do with the selling of water heaters and contains much useful information.

The price of the "Practical Salesmanship" Texts is $5.00 for the 12 volumes and are issued in three deliveries of one month apart.

Change in Name

Gas Equipment Corporation, 113 Purchase Street, Boston, Mass., has succeeded the Welsbach Water Heater Co., of N. E. Change has been made in the name only, as otherwise the company remains the same as before in every respect.

This company is now marketing their own water heater "Gasco" as well as the "Hotzone" and "Torridzone" Heaters manufactured by the Welsbach Company. They will also act as distributors for the other gas appliances manufactured by the Welsbach Company.

Papico H. & K. Odorizing Equipment

The Pacific Pipe & Supply Company of Los Angeles has recently placed on the market the Papico H. & K. Natural Gas odorizing apparatus.

The method of odorization is the automatic injection of odorant fluid into the gasoline by means of the differential pressure obtained across an orifice plate. The apparatus is used in conjunction with the standard orifice meter installation. The equipment consists essentially of a storage tank, float valve, chamber, strainers, sight feed, calibrating tube, odorant orifice, and necessary valves and fittings.

The amount of odorant introduced into the line is proportional to the volume of gas flowing. Control of the odorant fluid is obtained by varying the orifice size of the discs in the main line and in the odorant line.

It is claimed that a number of the California gas companies have standardized on this type of apparatus for odorization.

Complete information on the equipment may be had by request to the Pacific Pipe & Supply Co., of Los Angeles.

New Catalog on Brown Electric CO_2 Meters

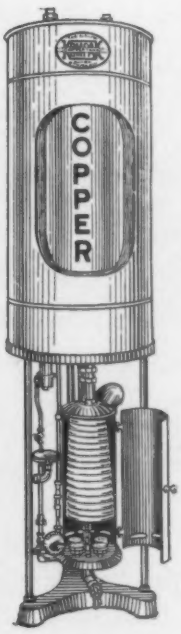
The Brown Instrument Company, Philadelphia, Pa., are issuing a new catalog on their Electric CO_2 Meters. The bulletin fully describes the functions of this instrument which records the percentage of CO_2 present in the flue gases in the operation of furnaces and it is claimed enables the furnace operator to run his furnace economically from the standpoint of fuel-saving. The Brown Instrument Company will furnish a copy of this catalog upon request.

QUANTITY vs. QUALITY

Many Gas Company Executives and Merchandise Managers, have seemed to feel that for "Quantity" sales of Automatic Storage Heaters, a very low price was necessary.

1930 demonstrated the fallacy of this idea. Kompak Copper sales were nearly doubled during a supposedly bad business year.

The present price of Copper Kompaks offers so much for the dollar invested, that a greater number of heaters can be sold than when cheap competitive heaters are used.



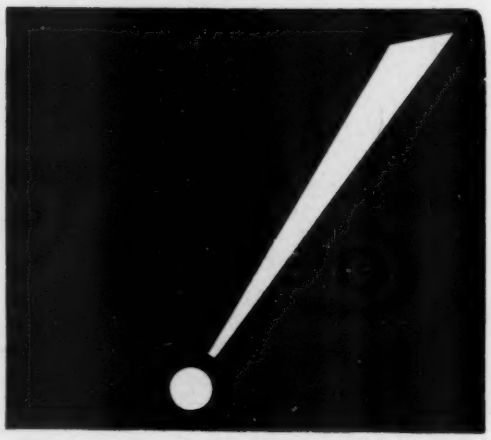
THE KOMPAK CO.

Automatic Thermostatic Gas Water Heaters

NEW BRUNSWICK
NEW JERSEY

KOMPAK

"PATROL FLASH"

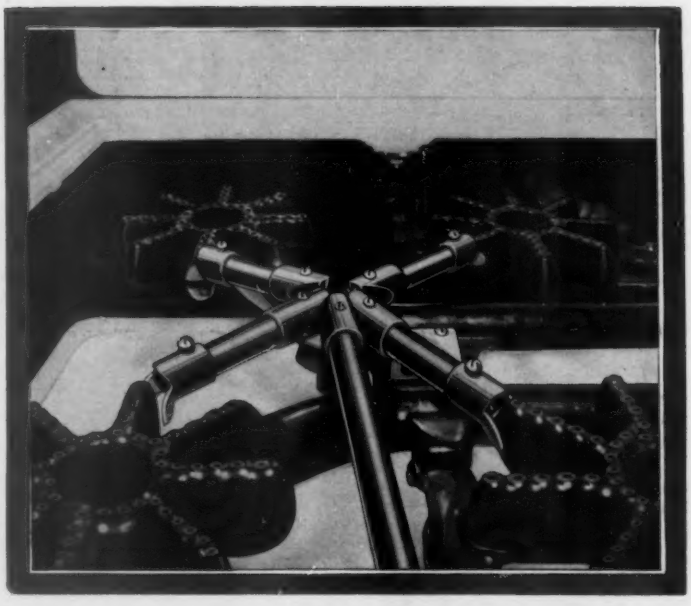


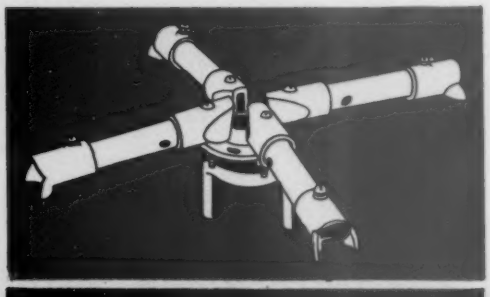
"PATROL-Flash" lighter for gas ranges is a sales feature — to sell gas ranges. There have been few improvements in the gas range with such immediate appeal to the customer.

Or so low in price.

Few with such interest compelling demonstration features — with so much to talk about. It is a convenience that delights the woman. Ask her.

She merely turns on the gas with one hand. The burner flashes aflame instantly. No other manipulation or operating tricks to learn.





"Patrol-Flash" is thoroughly automatic. "Patrol-Flash" is pretty. Finish is dull nickel. A. G. A. approved on several ranges. It is a thoroughly "engineered" product—produced by well-known engineers in the gas appliance industry.

• • •

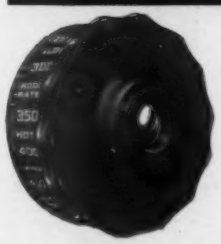
Extra tubes for simmer burner and oven lighting furnishea with standard model "Patrol-Flash" lighter at slight additional cost.

THE PATROL VALVE COMPANY

Cor. Locust Ave. and W. 114th St. . Cleveland, Ohio

Patents Pending

Patents Pending



If it hasn't got a RED WHEEL it's not a MAGIC CHEF

TWO Attractively Priced MAGIC CHEF Models that will Stimulate Gas Range Replacements

MAGIC CHEF, in both the Tiffin and Doric Models, completely satisfies the demand for modern style and beauty in gas ranges. Both of these Magic Chefs are thoroughly dependable and efficient cooking units, each of ample capacity to serve ten people.

Yet the retail prices are low enough to meet successfully the sales competition of ordinary gas ranges which Magic Chef now makes obsolete.

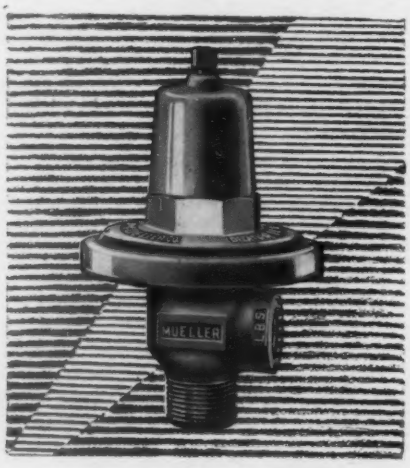
These beautiful and attractively priced Magic Chefs are bound to create a demand that will stimulate replacement of old gas ranges. They are substantial business builders that are certain to result in increased prestige and profits for every dealer who handles them.

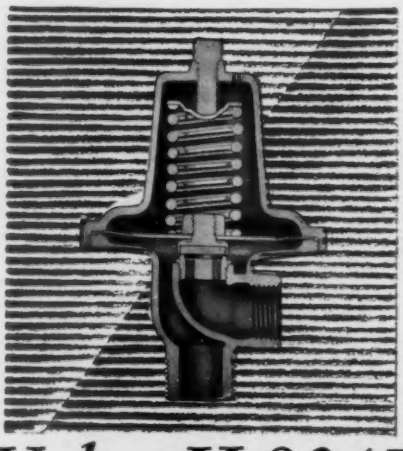
For full details write American Stove Company, Department C, 801 Chouteau Avenue, St. Louis, Mo.

Magic Chef

AMERICAN STOVE COMPANY • **World's Largest Manufacturer of Gas Ranges**

NEW YORK · PHILADELPHIA · ATLANTA · CLEVELAND · CHICAGO · St. LOUIS · SAN FRANCISCO · LOS ANGELES





To relieve dangerous pressure in hot or cold water, air and oil

Specify MUELLER *Valve H-9045*

MUELLER H-9045 is especially designed to relieve dangerous and excessive pressures. While it is particularly adapted to hot or cold water installations, it works equally well with air or oil. This MUELLER valve is diaphragm-operated and of all-bronze construction. Diaphragms are made of phosphor bronze material with a diaphragm area thirty-five times its seat area to assure sensitive operation.

Write us for full information on this MUELLER Relief Valve —it is fully warranted by the MUELLER Company, in business since 1857.

MUELLER CO. (Established 1857) Decatur, Illinois. *Branches:* New York, Dallas, Atlanta, San Francisco, Los Angeles, Chicago. *Canadian Factory:* MUELLER, Limited, Sarnia.

MUELLER

TRADE MARK REG. U. S. PAT. OFFICE

The NEW STAR

S.G.E. "CONSOLE"

THE NEWEST STYLE . . . . . AT POPULAR PRICES

The new Seven Star Console has been enthusiastically received by live merchandisers who are making it the key range of many Spring Campaigns.

The Console combines smartness with utility . . . at popular prices.

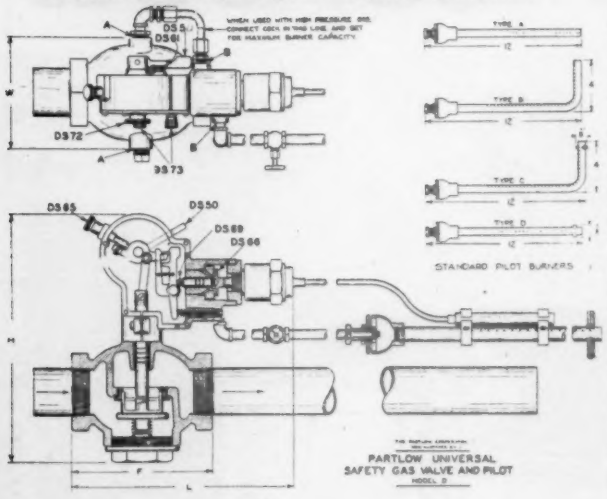
Modern design, color and handsome marbled finish give it eye appeal. No other range, at any price, gives all its convenience features. And its moderate price will agreeably surprise you.

Ask for details on the various colorful finishes and models.

Information on merchandising plans gladly sent

STANDARD GAS EQUIPMENT CORPORATION, 18 E. 41st St., New York

PARTLOW
SAFETY GAS VALVE and PILOT



A NEW IDEA IN SAFETY PILOTS

Which makes every kind of gas-burning appliance absolutely safe in the hands of the most careless operator

The function of this gas valve is to shut off the gas supply to the pilot and the main burner in the event that the pilot light becomes extinguished or the gas supply is interrupted.

The principle of operation is based on the expansion of mercury in a thermostat bulb which is heated by the pilot burner.

An additional feature of this valve consists of a means to hold the valve in an open position, temporarily, so that the burners may be lit without waiting for the thermostat to heat up

The valve is not affected by gas pressure, thermal content of gas or fluctuation of the flame from draughts.

Send for illustrated folder which explains this Safety Pilot more fully.

THE PARTLOW CORPORATION
New Hartford, N. Y.

PARTLOW
TEMPERATURE CONTROLS

TRADE CATALOGS

Published by manufacturers of Gas Equipment and Appliances for you. Order by number, using coupon on Page 104.

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A. B. C. SELF CLINKERING GENERATOR
The Western Gas Construction Co. 88
ADVANTAGES OF WELDED CONSTRUCTION
Western Gas Construction Co. 451
"AMERICAN" GAS AND METER TESTING APPARATUS
American Meter Co. 320
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Connelly Iron Sponge & Governor Co. 289
BALANCE GOVERNORS
Connelly Iron Sponge & Governor Co. 290
BACK PRESSURE VALVES
Connelly Iron Sponge & Governor Co. 295
BECKER TYPE COMBUSTION COKE & GAS OVENS
The Koppers Construction Co. 235
BECKER TYPE BY-PRODUCT COKE AND GAS PLANTS
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The Bartlett Hayward Co. 56
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The NEW *Improved* ELECTROLUX *offers*

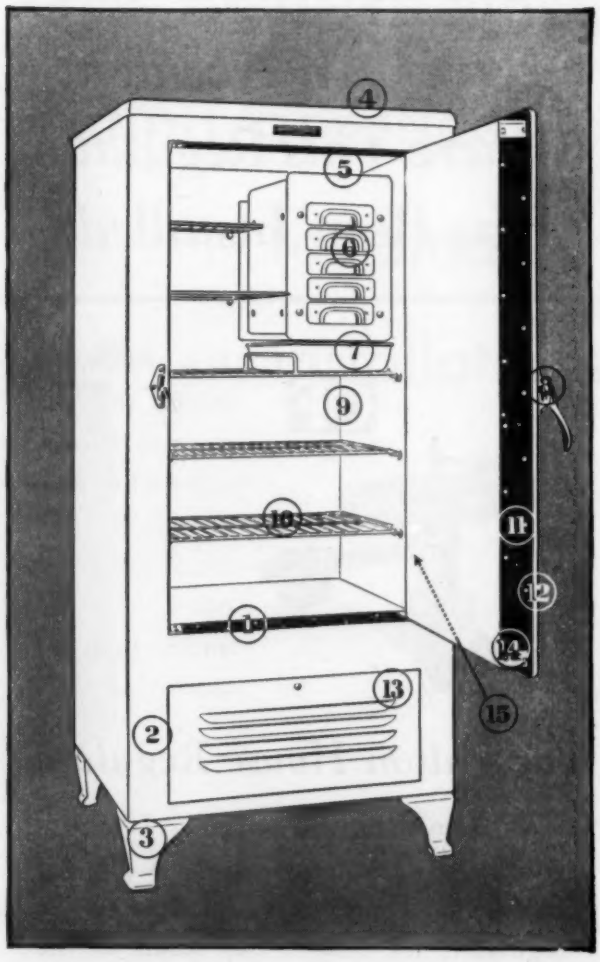
5 Additional Models
15 New Features

WE couldn't improve the simple, reliable Electrolux principle—but we've made the cabinets more luxurious than ever. Fifteen new, practical features have been added to Electrolux, the Gas Refrigerator. Check them over and see how the new Electrolux is better built, better looking than ever before. Housewives, prospects, can see and understand these features. They are the things that will make gas refrigeration more popular than ever, that will help you increase gas consumption in your territory.

The new models will help, too. Five new household and *commercial* models have been added to the eight regular household types. Among the newcomers are a special buffet box—called the "Westchester"—an ice-cream cabinet, and a storage refrigerator. Every grocery, delicatessen, club, dairy is now a prospect for gas refrigeration.

Sales Helps Ready Now

Catalogues, newspaper announcements, and a carefully worked out plan to secure apartment house business (Plan A) are waiting for you. Your first step in the drive for gas refrigeration business this year is to write, wire or telephone for this sales information. Address Electrolux Refrigerator Sales, Inc., Evansville, Indiana.



15 Important Features of the NEW IMPROVED ELECTROLUX

1. Panelite door frame trim with chromium-plated screw heads.
2. Exterior of standard Electrolux quality.
3. New artistic all-white legs. Easy to clean under cabinet with broom or mop.
4. Smooth, flat top. Used for table-top or dish storage.
5. Good-looking Chilliator assembly, porcelain covered.
6. Individual, self-sealing tray fronts of chromium. Cannot rust.
7. Practical chill tray arrangement. Gives more shelf room, eliminates waste of storage space.
8. Trigger-snap door latch of chromium plate. Facilitates opening and closing of door.
9. Beveled corners inside . . . easy-to-wipe porcelain lining. Makes cleaning easy.
10. Ribbon-type shelves. Prevent bottles and dishes from tipping over.
11. Panelite door trim with chromium screw heads.
12. Improved long-life gaskets.
13. Automatic gas lighter.
14. Chromium-plated hinge—brass door corners and door-frame corners.
15. Chromium-plated hinges in modern relief design.

ELECTROLUX

THE *Gas* REFRIGERATOR

Never An Accident Where This Regulator Has Been Installed--

It is absolutely essential that safety precautions be taken where houses or small consumers of gas are supplied from lines under high pressure.

The Fulton House Regulator

was designed for this purpose. It is provided with an Automatic Cut-off. Should any accident happen to the line or the regulator, no danger can result to the consumer. The Automatic Cut-off provides automatic safety—*real safety!* For this reason, there has never been an accident where a Fulton Regulator has been installed.

Write for our catalogue. Also ask for our booklet containing directions for setting and operating all types of gas regulators. Gas men will find both of value.

The Chaplin-Fulton Mfg. Co.

Organized 1884—Oldest Builders of Gas Regulators in the Country. Built in All Sizes. From 1 inch to 24 inches; For All Service. 1 Oz. Up to 2,000 Lbs. Pressure to Square Inch.

28-40 Penn Avenue **Pittsburgh, Pa.**

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New Ideal Arcola Gas Boilers make hot water radiator heating practicable for small installations

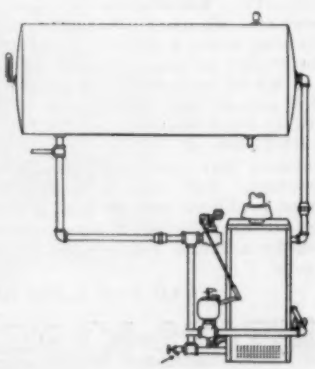
Here is a new field for sales and profits—the New Ideal Arcola Gas Boiler for small house heating installations and for hot water supply. Every feature of this boiler has been designed exclusively to meet the special requirements of small hot water installations. All the quality of product and all the exclusive control features of the other Ideal Gas Boilers have been included in this smaller compact model.

Either with or without jacket it is so attractive and so compact that it can be placed in any room and connected with radiators wherever needed.

This new heating plant is particularly adapted to small homes without basements, apartments, offices, stores, tea rooms, garages, barber shops and beauty parlors which have no central heating plant.

We will be glad to send a complete description of this new appliance that is opening up new opportunities for sales and profits.

For Direct Hot Water Systems the Ideal Arcola Gas Boiler makes an excellent installation. It has the advantage of compactness, high efficiency with large capacity and adequate automatic controls.



Manufactured by

AMERICAN RADIATOR COMPANY

DIVISION OF

AMERICAN RADIATOR & STANDARD SANITARY CORPORATION

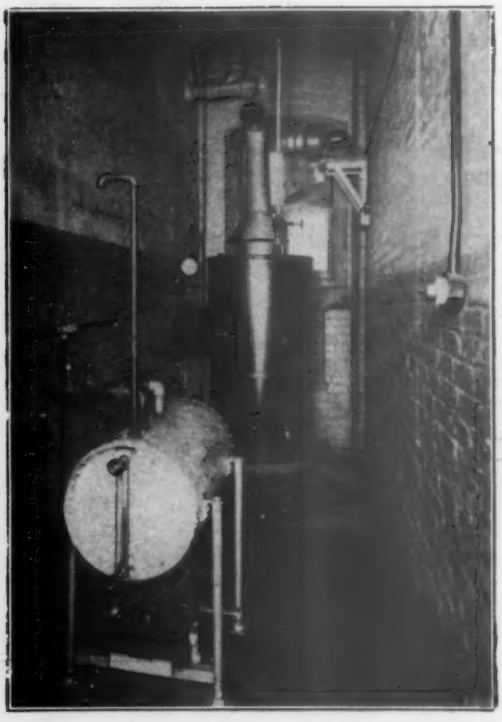
40 West 40th Street, New York City

Distributed by

AMERICAN GAS PRODUCTS CORP.

CHRYSLER BLDG., NEW YORK

Tell Your Prospects *this* Story of Economy:



"Saves $731.00 a Summer on Process Steam"—

Above is shown a typical KANE process steam installation, consisting of a 10-h.p. KANE Gas Boiler and an M-K-O Automatic Boiler Feed and Condensation Return System in the Sidney Ross Company, of Newark, N. J. *Tell your prospects that they can duplicate this installation*—This installation is especially noteworthy because there was obtained a definite saving of $731.00 a year *by shutting down a 150-h.p. coal-fired heating boiler during the 85-day summer season*, relying entirely upon the 10-h.p. KANE boiler for all process steam needs.

The actual cash investment in the Kane Boiler and M-K-O Feed System, by careful estimates, here YIELDS A RETURN of 77.8%. Such a return is decidedly impressive, but not exceptional when KANE boilers are installed. Tell your prospect that his summer process steam problems can be solved *with proportionate gain to him*, if he anticipates these coming summer months and installs a Kane beforehand! Let us give you further details.

SEND FOR KANE BULLETINS!

MEARS-KANE-OFELDT Inc.

1903-1915 EAST HAGERT ST. PHILADELPHIA

New York—9 Park Place Buffalo—Walbridge Bldg.
Boston—100 Arlington St. St. Louis—2010 Locust Blvd.
Chicago—325 W. Huron St. Birmingham—American Trust Bldg.

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DISPLACEMENT AND ORIFICE MEASUREMENT

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BARBER

SUPERIOR
GAS PRESSURE

REGULATOR

Build GOOD WILL

by

INSTALLING A BARBER REGULATOR ON EVERY HOUSE SERVICE LINE

A GUARANTEE AGAINST HIGH GAS BILL COMPLAINTS AND SERVICE CALLS

THE BARBER GAS PRESSURE REGULATOR IS A RELIABLE PRECISION DEVICE.

Small, rugged, durable and neat, its unusual accuracy is built into it to stay. High grade bronze valve with all-brass working parts. Springs of special phospher bronze. Diaphragms of highest grade sheepskin, especially treated to withstand normal house service gas pressures.

Barber Pressure Regulators are made with interchangeable parts, maintain the UNIFORM and CONSTANT supply of gas to the burners that prevents incomplete combustion and waste of GAS, eliminates risk of failing pilot lights and puffing out of burners.

Sizes, ¼-⅜-½-¾-1-1¼-1½ and 2 inches.

NOTE THESE SUPERIOR FEATURES:

POINT OUT THESE FACTS TO YOUR CUSTOMERS AND THEY'LL MAKE A SMALL INVESTMENT IN A BARBER GAS PRESSURE REGULATOR.

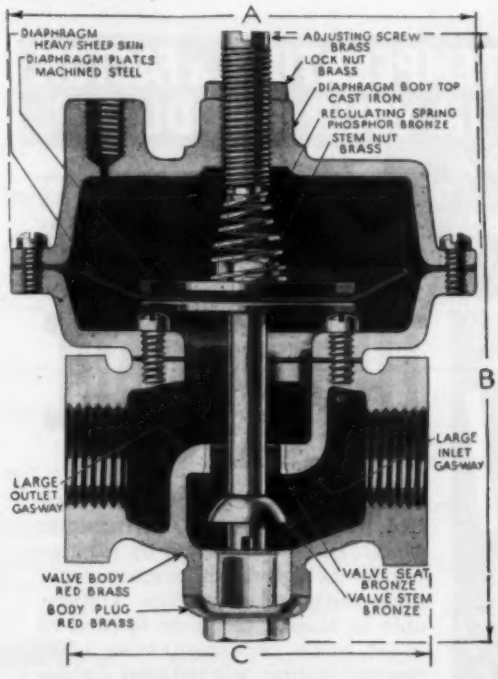
SAFETY—Provides SAFETY from high and irregular gas pressures — that produce fumes and poisonous unburned gases.

ECONOMY—Prevents waste of gas, quickly paying for itself, through lower gas bills.

SERVICE—Assures more satisfactory service from all appliances served by the meter.

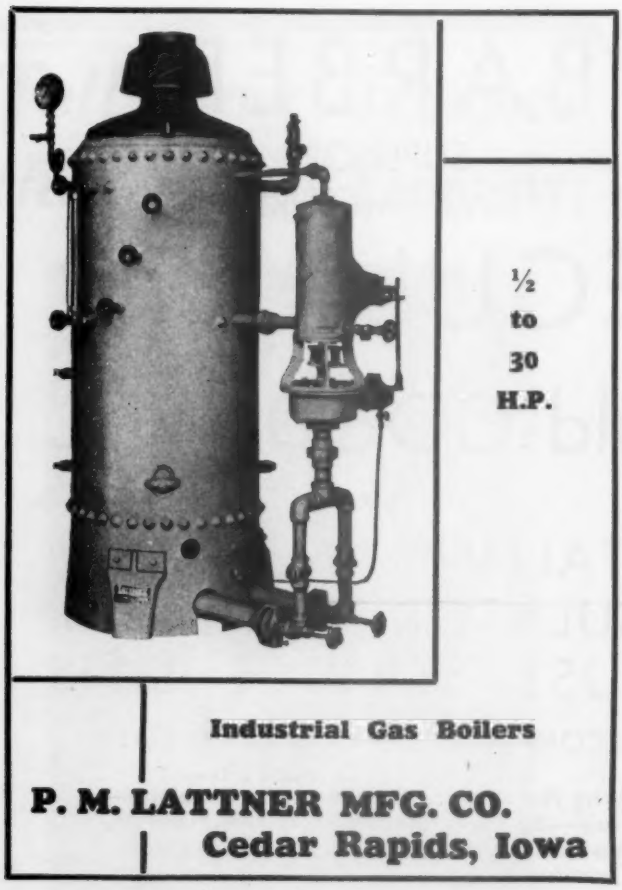
Why Not Order a Sample Barber Regulator—Now—To Prove the Merits of this Profitable Business Builder?

Consumer's literature, Sales Helps, Discounts, etc., will be sent to you, upon request. Write us today.



BARBER *Automatic* JET GAS BURNERS

THE BARBER GAS BURNER CO., Burner Specialists, 3702-04 Superior Ave., Cleveland, Ohio



Industrial Gas Boilers

P. M. LATTNER MFG. CO.
Cedar Rapids, Iowa

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Pittsburgh Equitable Meter Co. 267
EMCO DEMAND METER
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MOHAWK HI-SPEED TRADER TOOL CHART
Mohawk Asphalt Heater Co. 576
MOHAWK HI-SPEED UTILITY TRAILERS, 2 AND 4 WHEEL
Mohawk Asphalt Heater Co. 577
CORK DIPPING PANS
Mohawk Asphalt Heater Co. 578

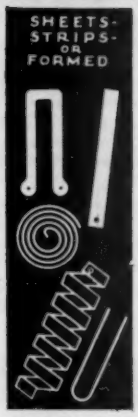
IS TEMPERATURE a FACTOR IN YOUR PRODUCT?

OFF! OFF! ON! OFF! ON! ON! OFF! OFF!

then CONTROL IT AUTOMATICALLY with

CHACE THERMOSTATIC METAL
"It Bends With the Heat"

SHEETS-STRIPS-OR FORMED



Secure automatic temperature control by using Chace Thermostatic Metal (Bi-Metal) known by reputation for its high sensitivity, accuracy, uniformity and reliability. Obtainable in sheets, strips or formed to meet your requirements. 1200 degrees Fahrenheit without distortion. Used by many manufacturers of burners, heaters and automatically controlled safety devices. Consult our Engineering Department.

Manufactured by

W. M. CHACE VALVE CO.
1610 BEARD AVE. DETROIT, MICH.

Gas Appliances

INDUSTRIAL EQUIPMENT

AIR HEATER BULLETIN
Surface Combustion Co. 505
RIVET HEATERS
Surface Combustion Co. 506
POTATO CHIP FURNACES
Surface Combustion Co. 507
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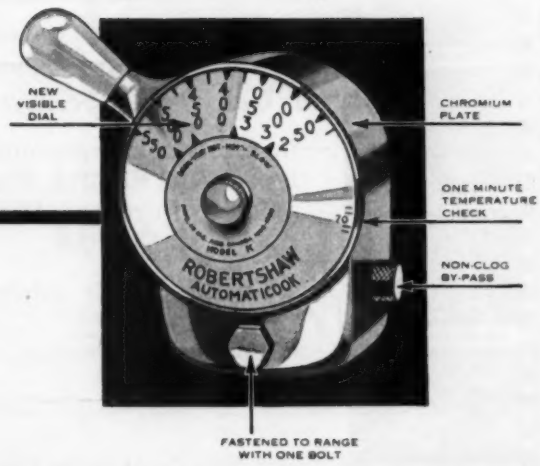
ROBERTSHAW AutomatiCook



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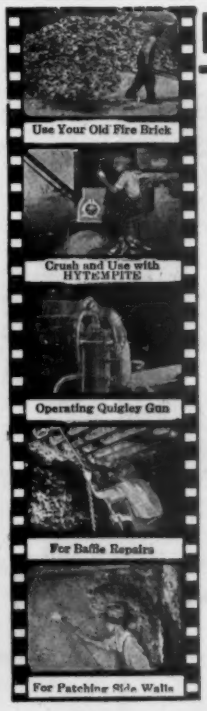

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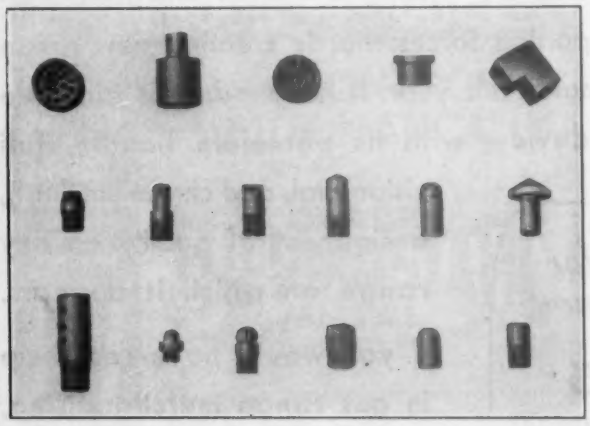

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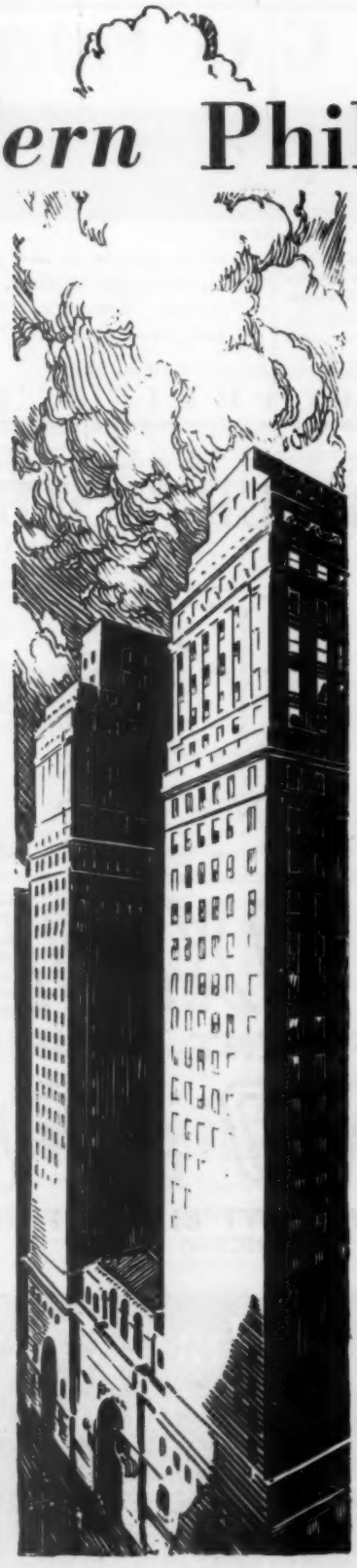

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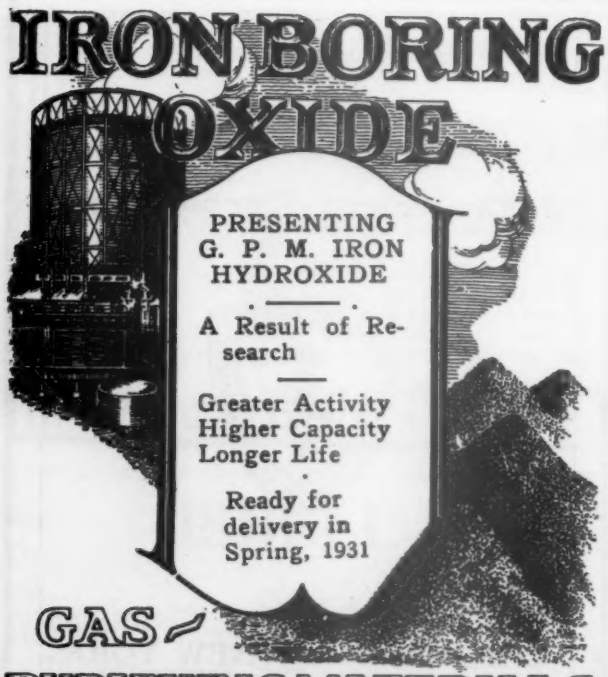

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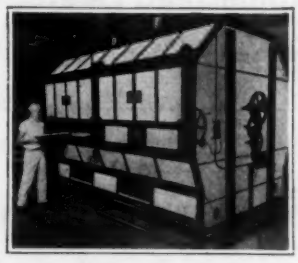

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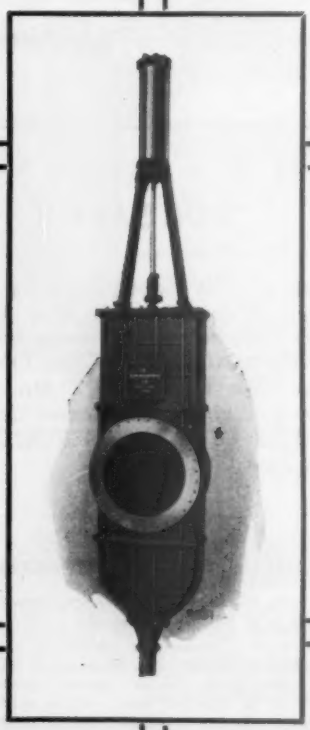

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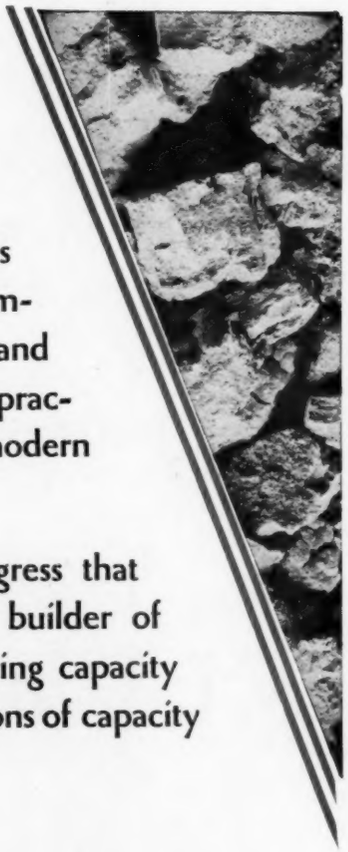

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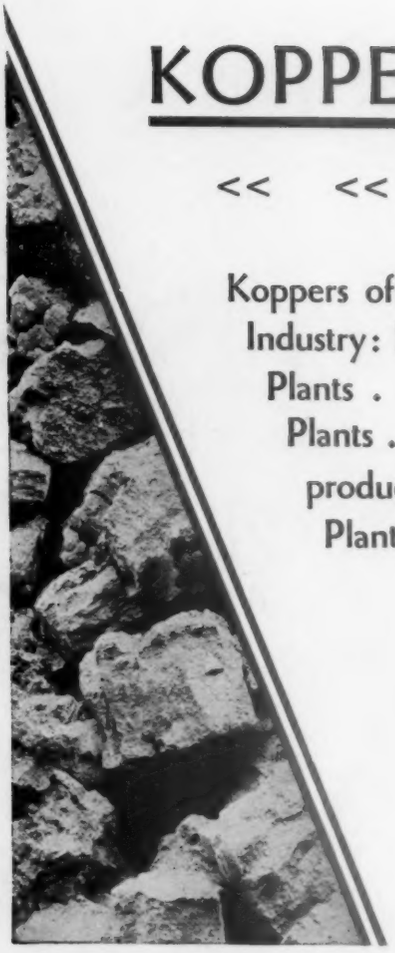

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GAS JOURNAL
Established 1859 *Pioneer of the Gas Industry*

Manufactured and Natural Gas

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Vol. 134, No. 5 May, 1931 Whole Number 3689

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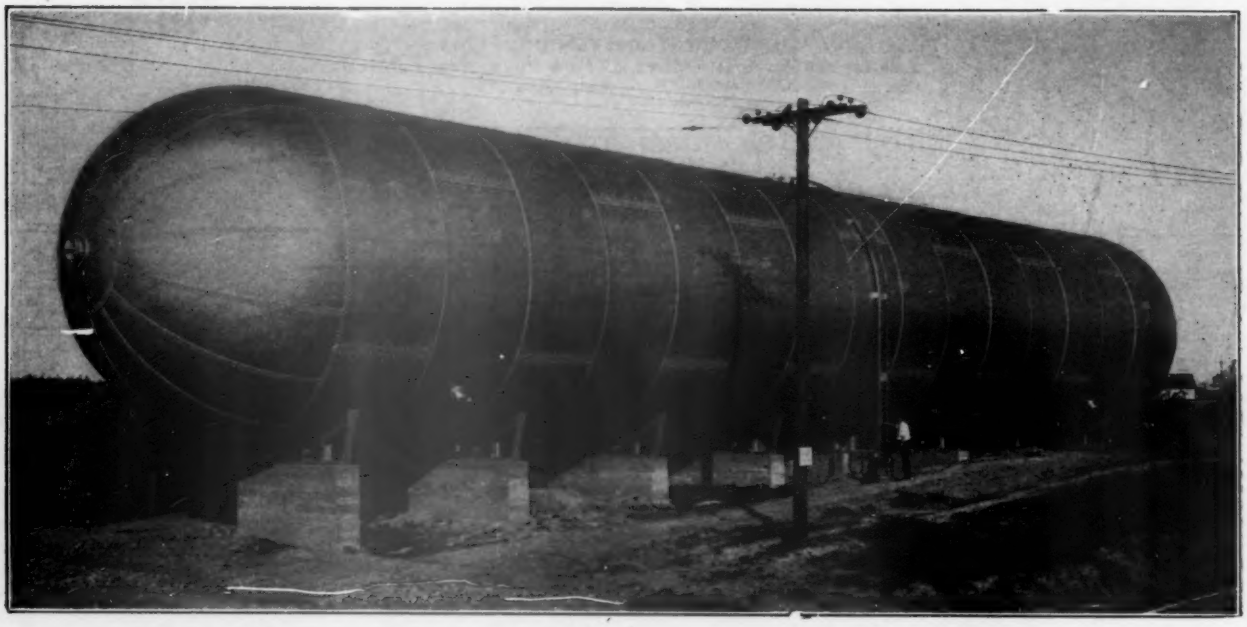

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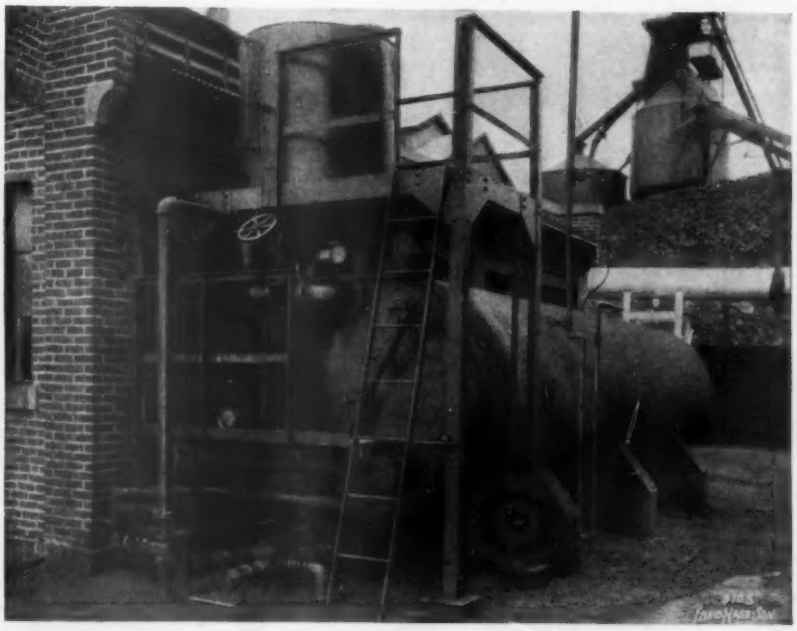

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WAY TO DO IT » » » » » » »
the C-H CALORIMIXER

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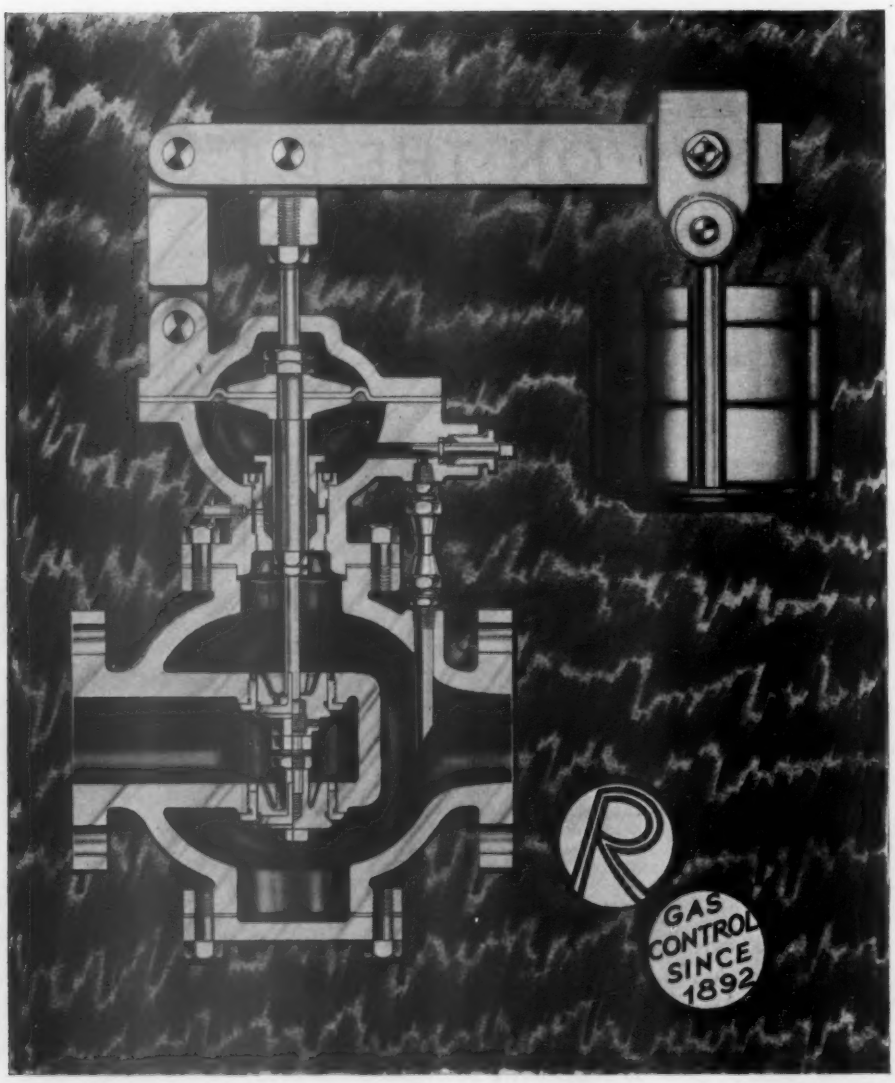

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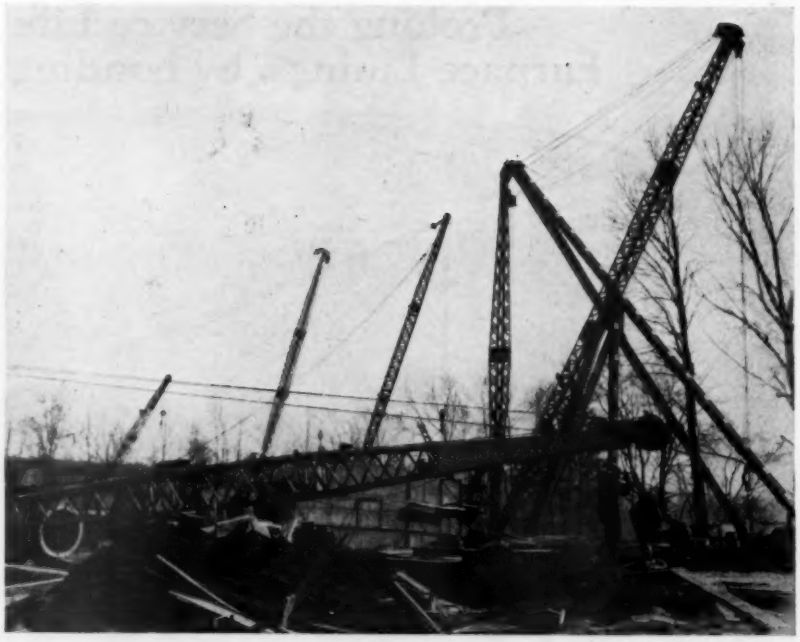

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	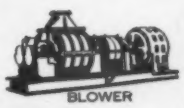 BLOWER	Blowing Water Gas Sets—Revivifying Gas Fired Heating Systems Gas Fired Bakers' Ovens Gas Fired Enameling Ovens Gas Fired Annealing Furnaces Pneumatic Conveying

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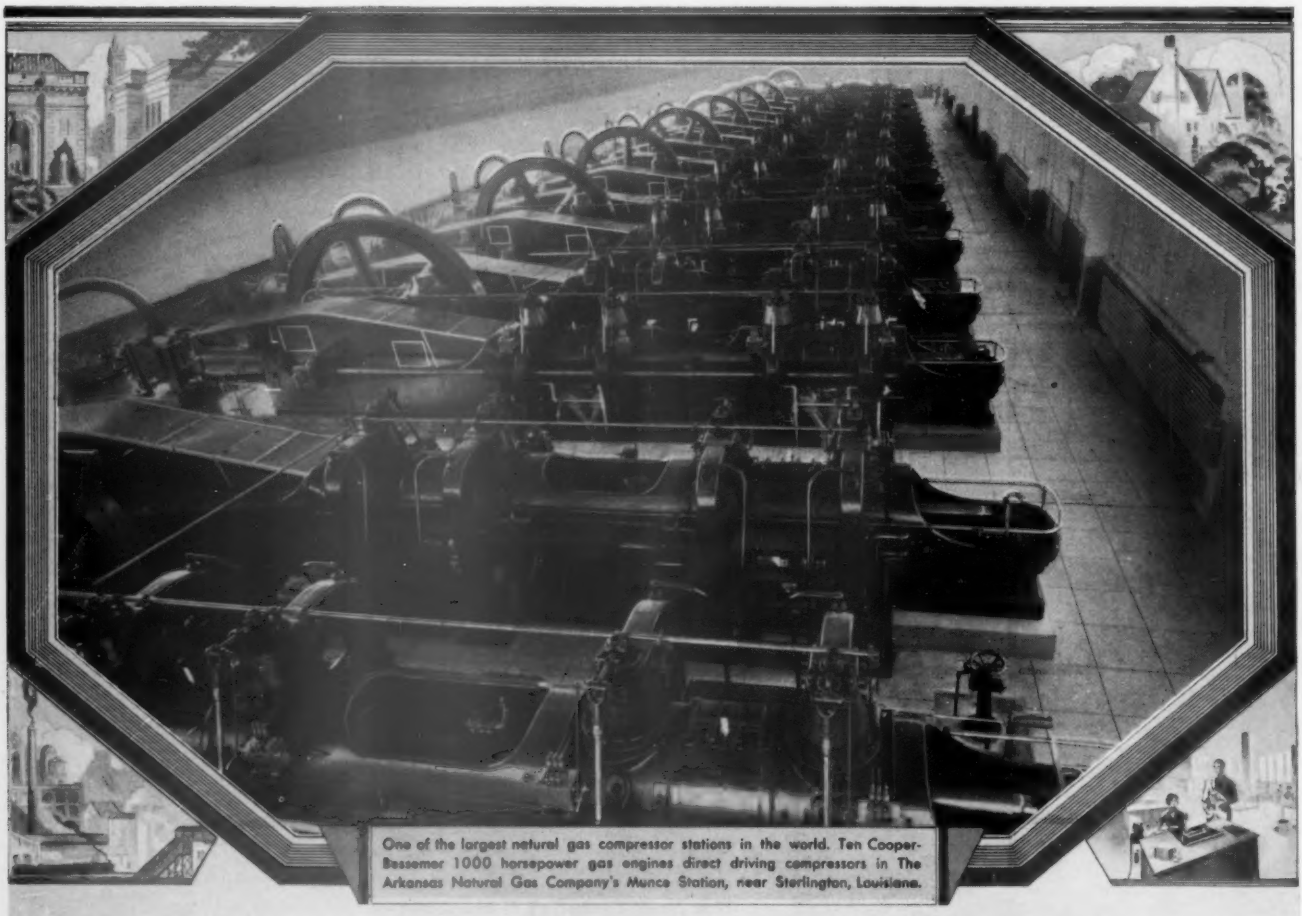

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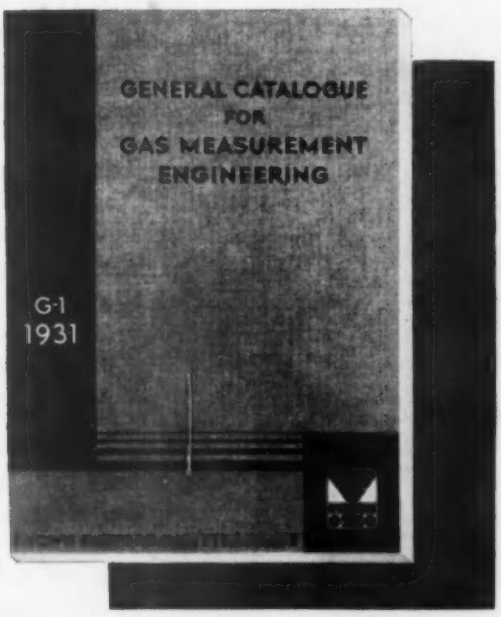

CATALOGUE G-1, 1931 is more than an ordinary catalogue. It does serve as an index to American Meter Company's complete line of products. But its usefulness does not end there.

Catalogue G-1, 1931 is purposely designed for comprehensive reference. Its 220 pages contain much information on gas measurement engineering that can not be obtained elsewhere. It adequately describes each product, and serves both as a guide in purchasing and as a reference to the vast amount of additional operating information and data that is available from American Meter Company.

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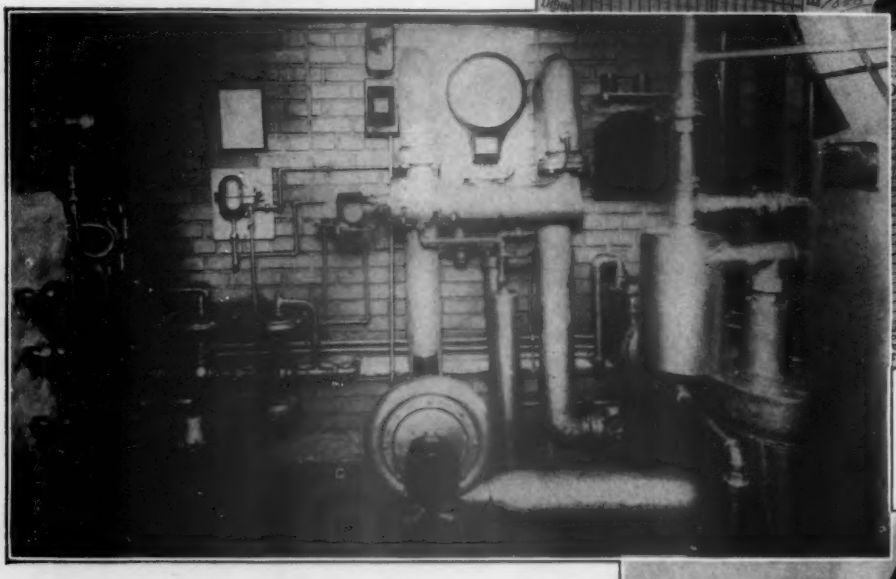
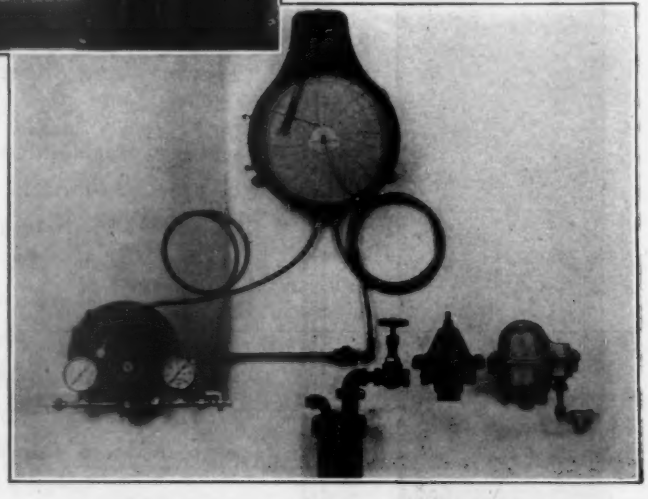
AUTOMATIC CONTROL OF HUMIDITY IN THE *Saturization of Natural Gas*



Installation of Bristol's Humidity Recording and Control System at Atlanta, Ga.

Sectional reproduction of chart with record showing humidity control over period of 24 hours.



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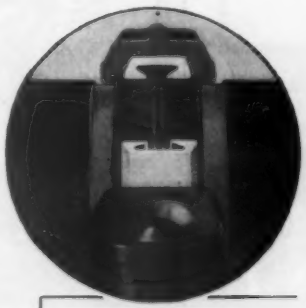

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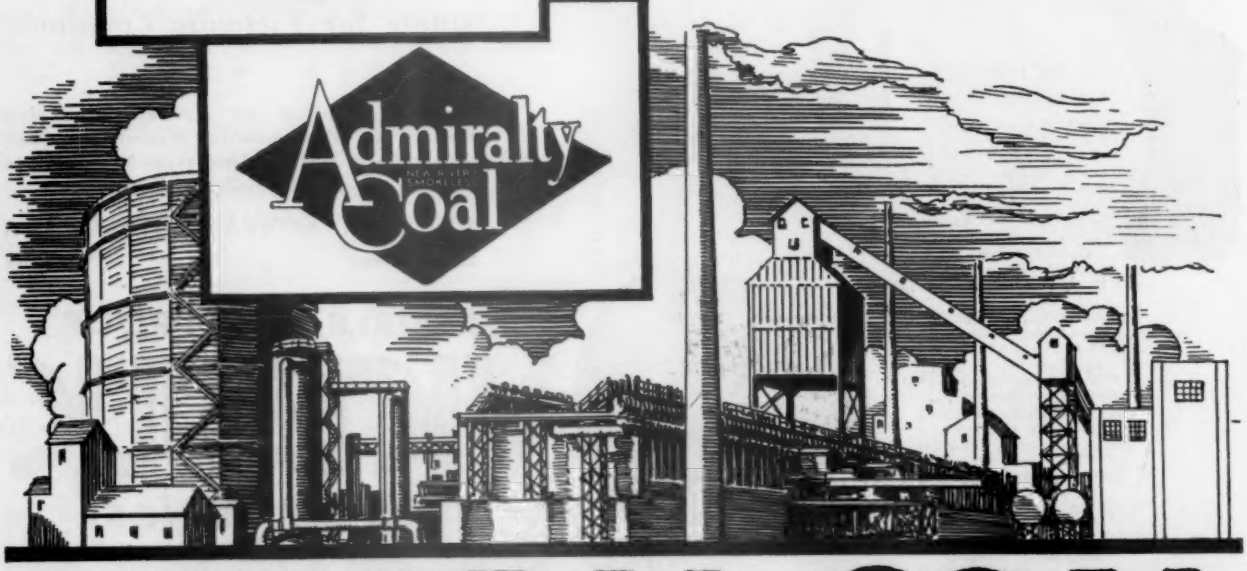

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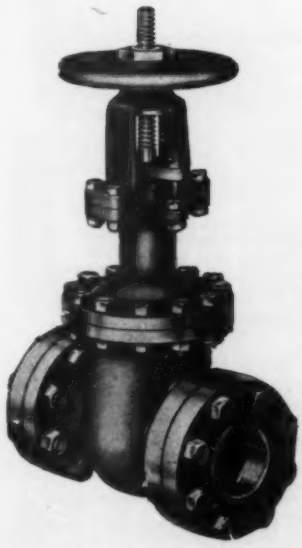
Soundness and simplicity of mechanical construction insure the long life of Darling Valves—for they do stand up under adverse conditions.

The revolving gate disc, an exclusive Darling feature, is one of the most important factors in prolonging the life of Darling Gate Valves.

The complete story behind Darling Valve performance will be gladly sent you on request.



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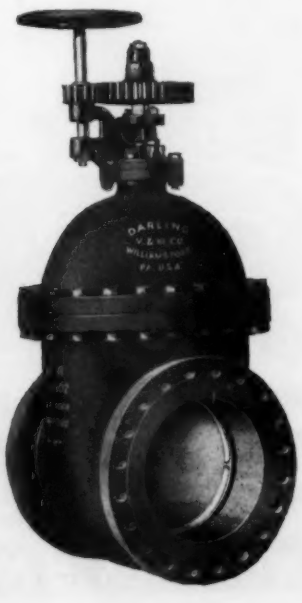
Darling Outside Screw and Yoke Semi-Steel, Flanged End Gate Valve, with companion flanges bolted on. Dar-a-loy trimmed.



Darval Semi-Steel Valve Dar-a-loy trimmed—for natural Gas Pipe lines and compressor stations.

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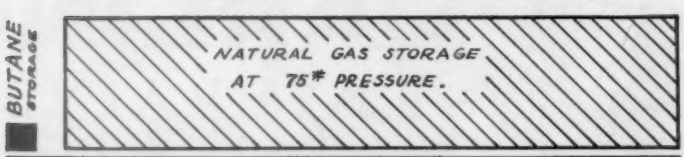
are often possible by supplementing Natural Gas with BUTANE

In the mad rush to furnish natural gas service, the economy of a BUTANE installation is often overlooked. The cost of delivering natural gas varies directly with the length of the line and inversely as the square root of the load factor, and consequently, in many situations involving poor load factor, long transmission lines, or both, a BUTANE installation will deliver gas to distribution systems at a lower cost.

Where natural is in use, BUTANE standby installations to insure against interruptions in service and to care for peak load demands, present many economies. Consider, for example, that natural gas at 75 lbs. pressure requires a storage tank 115 times as large as a BUTANE storage of equal B. t. u. capacity!

COMPARATIVE SIZE OF NATURAL GAS AND BUTANE STORAGE OF EQUAL THERMAL CAPACITY



We will be glad to discuss these possibilities with you.

GAS MANUFACTURING DIVISION

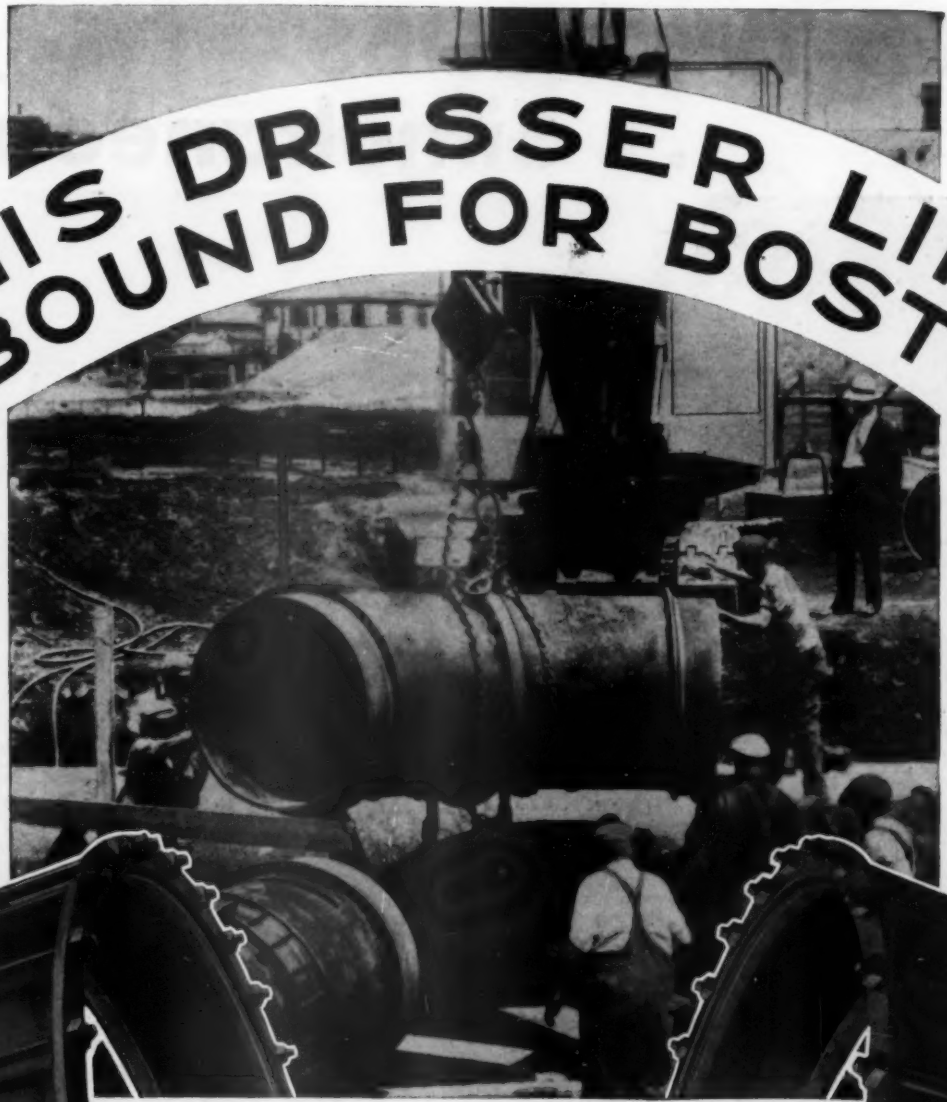
« « PHILFUELS COMPANY » »

(Subsidiary of Phillips Petroleum Company)

7-101 GENERAL MOTORS BLDG.

DETROIT - - - MICHIGAN

THIS DRESSER LINE IS BOUND FOR BOSTON



In both natural and manufactured gas distribution from New England to Texas, and from Florida to Washington—Dresser Couplings are the one most commonly used pipe line accessory. Probably more than 100,000 miles of Dresser Coupled pipe are in service, maintained satisfactorily at pressures from 250 to 500 pounds.

DRESSER COUPLINGS DOMINATE

S.R. DRESSER MANUFACTURING COMPANY, BRADFORD, PA.

DOES TWO JOBS . . Simultaneously

Tamps . . . . Backfills

MANY municipalities require all trenches to be tamped. This formerly involved an annoyingly heavy expense. When this work was done by hand, results were always uncertain. In many cases the "fill" would settle, causing a traffic hazard and necessitating additional maintenance expense.

Now, this is no longer necessary. The Cleveland Tamper-Backfiller will quickly do this work at a mere fraction of the hand-labor cost, and do it thoroughly and permanently—*always*. Every inch of trench is packed *tight* and, by replacing more dirt, less remains to be hauled away—an additional saving.

The front and rear of your trench jobs can now be kept close together, for while excavating and pipelaying progress, the Tamper-Backfiller is replacing the soil right on their heels, leaving less trench open overnight. Even when tamping is not required by law, many companies are doing so because of the additional economy and safety involved.

And the Cleveland Tamper-Backfiller is also an excellent backfiller, thus combining these two related operations on one compact, crawler-mounted unit, one-man operated.

It may be transported quickly and cheaply on its own special trailer, similarly to Cleveland Trenchers.

THE CLEVELAND TRENCHER COMPANY

"Pioneers of the Small Trencher"

20100 ST. CLAIR AVENUE CLEVELAND, OHIO

THE CLEVELAND TAMPER-BACKFILLER

Take a LONG LAST LOOK

. . at this pipe line

(it's the last anyone will ever see of it)

DOWN in Texas, another line of Doublex Simplex Pipe joins the dear departed. Four feet under the sod, it carries natural gas at high pressure . . . and will carry it for generations to come. The accompanying photograph shows the *corpus* just before the sod was shovelled in. The crew moved on to the next section without sorrowful ceremony. There's solid satisfaction in laying pipe you can forget. Doublex Simplex Pipe is a source of this satisfaction. It is a high-pressure pipe made by the famous Mono-Cast centrifugal process and equipped with the special Doublex Simplex Joint—a stuffing box type of joint which is flexible yet leakproof. Actual field service and exhaustive tests by disinterested parties have won wide acclaim for this fine product of which we feel justly proud. Write nearest Acipco office for descriptive literature, specifications, prices, etc.

AMERICAN

CAST IRON PIPE COMPANY BIRMINGHAM ALABAMA

NEW YORK CITY CHICAGO MINNEAPOLIS KANSAS CITY CLEVELAND DETROIT DALLAS SAN FRANCISCO LOS ANGELES SEATTLE

315G

The excellent condition of *CAST IRON GAS MAINS*

laid in BOSTON *in* 1836

The early records of the Boston Consolidated Gas Company inform us that back in 1836 their engineers specified cast iron pipe for gas mains. Today—95 years later—certain of those ancient mains are still on the job and in good condition. Of course, some of the earliest cast iron gas mains have been removed from time to time, not because they were worn out, but due to street construction, re-routing and the need of greater capacity. However, in Boston today there are cast iron gas mains which were laid in 1836 and are still giving excellent service.

No wonder engineers prefer to specify modern cast iron gas mains for *modern* conditions. Notwithstanding the extraordinary service records which old cast iron mains have established, the cast iron pipe produced today is even better.

Modern cast iron pipe is scientifically produced by improved methods and equipment. The quality of the iron itself is improved as to uniformity by the development of laboratory control. And, of course, today's cast iron pipe is designed to serve under far different pressure conditions than would be possible for old-fashioned pipe to meet.

Engineers, contractors and city officials desiring information regarding cast iron pipe for gas, water or sewer mains are invited to write to Thomas F. Wolfe, Research Engineer, The Cast Iron Pipe Research Association, 309 Peoples Gas Building, Chicago, Ill.

[*Efficient mechanical joints for cast iron gas mains are now in use and obtainable for high-pressure gas distribution.*]

. . . shows the wisdom of laying modern *Cast Iron Gas Mains in* BOSTON TODAY

Cast iron pipe bearing the "Q-check" trademark is obtainable from the following leading pipe founders: Alabama Pipe Company, Anniston, Ala.; American Cast Iron Pipe Company, Birmingham, Ala.; James B. Clow & Sons, 219 N. Talman Avenue, Chicago, Ill.; Donaldson Iron Company, Emaus, Pa.; Glamorgan Pipe and Foundry Company, Lynchburg, Va.; Lynchburg Foundry Company, Lynchburg, Va.; National Cast Iron Pipe Company, Birmingham, Ala.; United States Pipe and Foundry Company, Burlington, N. J.; Warren Foundry and Pipe Company, 11 Broadway, New York.

Reg. Trade Mark

The "Q-check" symbol shown above has been adopted as the trademark of The Cast Iron Pipe Research Association.

CAST IRON PIPE

Memphis

ACHIEVEMENT

THE introduction of Natural Gas into Memphis marked the beginning of a most successful era of achievement...The Memphis Power and Light Company is to be heartily congratulated on its enterprise and vigorous merchandising effort which has resulted in a sales record so outstanding... Surface Combustion adds to its congratulations its very best wishes to the personnel of The Memphis Power & Light Company for ever increasing success in its field.

* * *

Surface Combustion appreciates the opportunity of working with The Memphis Power & Light Company in furthering the use of Natural Gas as a fuel.

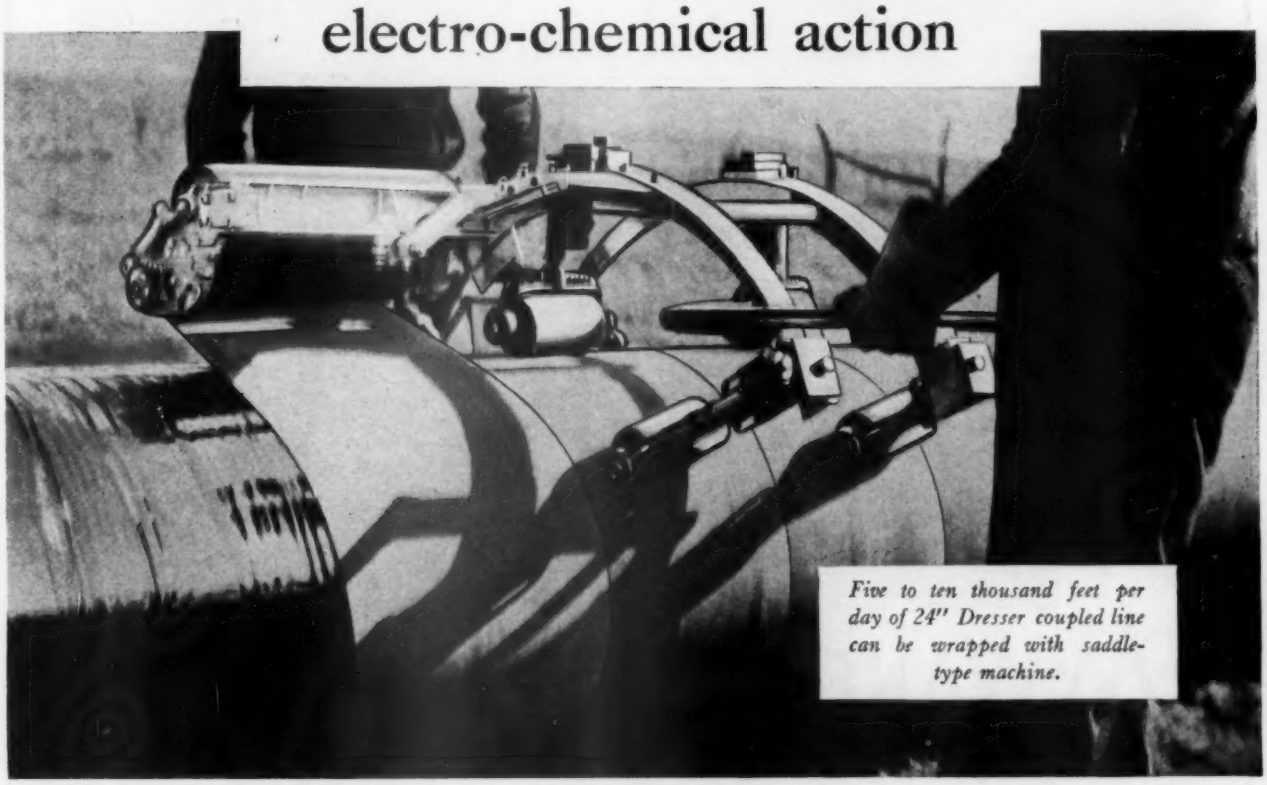
Surface Combustion

SURFACE COMBUSTION CORPORATION
TOLEDO, OHIO.

SALES AND ENGINEERING SERVICE
IN PRINCIPAL CITIES

wrap your pipe coating

for SECURITY against moisture penetration . . soil stress . . and electro-chemical action



Five to ten thousand feet per day of 24" Dresser coupled line can be wrapped with saddle-type machine.

ASBESTOS FELTS, because of their strength, immunity to rot and decay, and resistance to electrical and chemical action, have for many years provided the ideal reinforcement in all types of waterproofing construction.

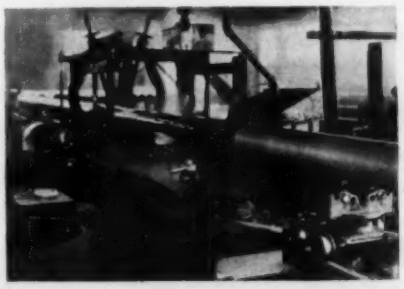
Owners of more than 10,000 miles of pipe lines have purchased security against corrosion by incorporating J-M Asbestos Felt Wrapper in their pipe protection. The Asbestos Felt Wrapper adds to the waterproofing provided by the bitumen coating and successfully combats electrolytic and galvanic actions.

It distributes the clod pressure and takes the shear and pull of soil action.

This permanent protection afforded by including J-M Pipe Line Felt Wrapper is secured at but a fraction of the cost of reconditioning.

The Johns-Manville corps of engineers is especially qualified to discuss pipe-line protection.

Get in touch with our local office or address Johns-Manville, 292 Madison Ave., New York City.

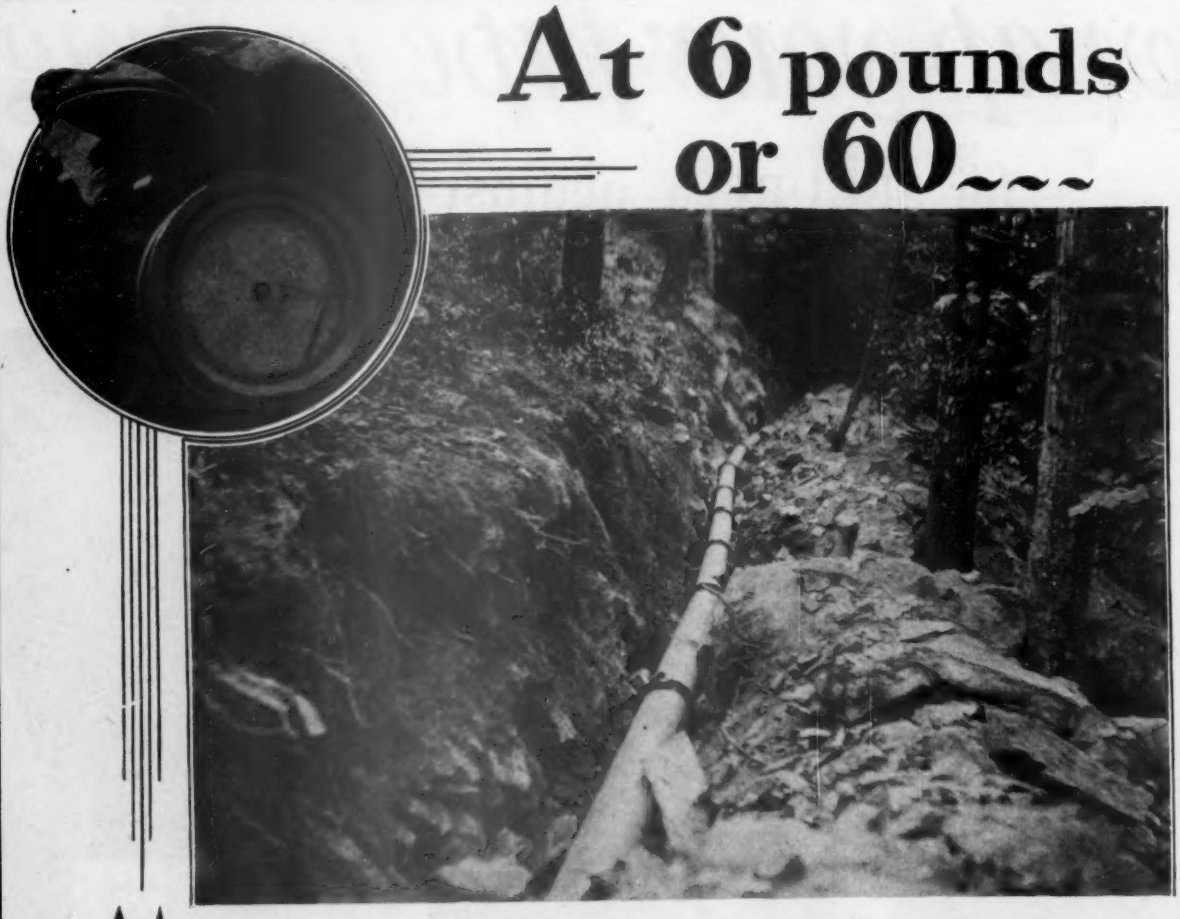


Johns-Manville Asbestos Pipe Line Felts being mill-wrapped under exact conditions of temperature control.

Johns-Manville Pipe Line Felts

Johns-Manville Felts can be applied bonded or unbonded — by hand or by machine —in mill, yard or field.

At 6 pounds or 60~~~



McWANE PIPE *stands the gaff!*

So fast has McWane cast iron gas pipe come to the front that some are not yet aware of its new position among the leaders.

First, it is straight, strong, sturdy—
Second, uniform—in every sense of the word—
Third, it is modern in weights and strengths, yet old-fashioned in being SAND-CAST.

Read the details of its superiority as tabulated at the right.

Better still, ask us what important gas company near you is using it. Then ask THEM about it!

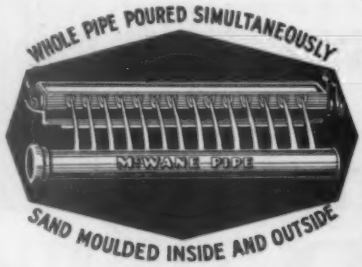
(Various joints for various pressures. Ask us.)

. . . made as small as 1¼-inch; as large as 12 inch.

Why McWane Pipe Wins

1. It is sand-cast.
2. Bell and Spigot type.
3. Cuts, taps, ships beautifully.
4. 16-foot lengths, above 3-inch size.
5. Over 30,000 lbs. tensile strength.
6. Over 2,600 lbs. transverse strength.
7. Modern in weights and uniformity.
8. Smooth Straight Pipe.
9. Utterly uniform Bells & Spigots.

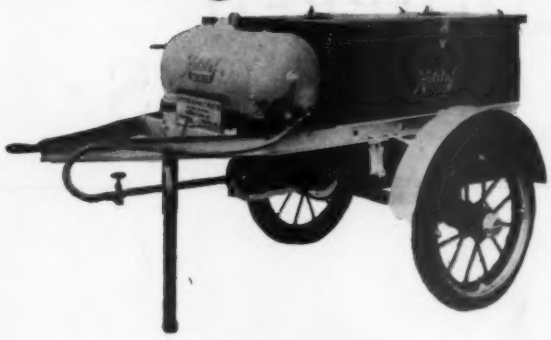
McWANE CAST IRON PIPE CO. BIRMINGHAM ALABAMA



PACIFIC STATES CAST IRON PIPE CO. PROVO, UTAH

208 S. La Salle Street CHICAGO
149 W. 2nd South Street SALT LAKE CITY
1807 Santa Fe Bldg. DALLAS
111 Sutter Street SAN FRANCISCO
417 S. Hill Street LOS ANGELES
226 Continental Oil Bldg., DENVER
1006 Grand Avenue, KANSAS CITY
611 Spalding Bldg., PORTLAND, ORE.
40 Exchange Place, NEW YORK

Investigate These Big Money-Savers!



Hotstuf

30% greater melting capacity
30% less fuel

HOTSTUF Asphalt Heaters are offered on their production capacity, rather than holding capacity.

You are interested in how much hot asphalt a heater will deliver, heated up to the temperature you want it, not how much it will hold.

The Patented Elevated Melting Chamber Feature around which all Mohawk Hotstuf Heaters are built will produce a continuous flow of hot asphalt within fifteen minutes after lighting the torch, at a rate better than thirty percent faster with approximately thirty percent less fuel consumption than other makes of the same rated holding capacity.

We welcome an opportunity to prove this on your job.

Five different capacities made in five different models to choose from.

Ask for Catalogue!

MOHAWK HI-SPEED TRAILER

Let your trucks carry Pay loads — not tools!

DON'T tie up a truck to carry tools. Every time one of your trucks carries tools it cheats you out of pay load. Trail the tools to the job in a Mohawk Hi-Speed Tool Trailer.

When you have one of these convenient, waterproof, all steel Mohawk Hi-Speed Trailers, you can count on having your tools always on the job and in safe keeping at night.

They are made to stand the gaff. All Steel, extra heavy welded, half elliptic springs, rubber tires, roller bearings. Special partitions and compartments for all tools.

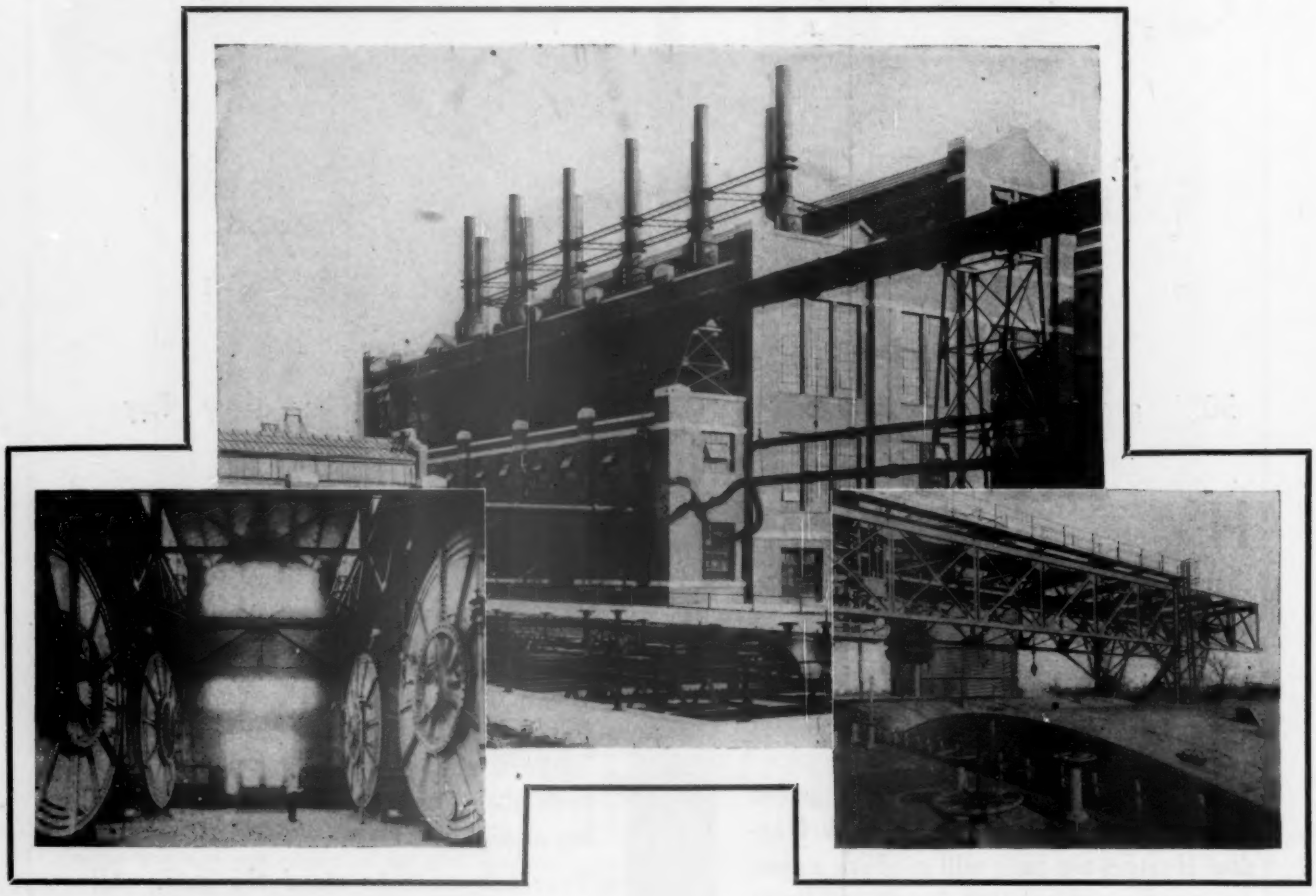
Made in sizes and designs to suit every condition, and can be trailed at truck speeds.

There's a place for every tool—keep every tool in its place.

Ask for Catalogue!

MOHAWK ASPHALT HEATER COMPANY
SCHENECTADY *Dealers in Principal Cities* NEW YORK

COMPLETELY EQUIPPED
WATER GAS PLANTS·



The Bartlett Hayward Company with broad engineering experience has the facilities to design, fabricate and erect complete Water Gas Plants with every detail thoroughly co-ordinated.

Coal Gas Plants
Carburetted Water Gas Plants
Blue Water Gas Plants
By-Product Plants
DeBrouwer Charging and Discharging Machines
Salt Water and Fresh Water Condensers
Tar Extractors
Gas Holders

THE
BARTLETT
HAYWARD
COMPANY
Baltimore / New York

Purifiers
B. H. Co. Vertical Centrifugal Scrubbers (Feld Type)
B. H. Co. Thickener (Center Type)
Steel Tanks
Vertical Waste Heat Boilers
B. H. Co. Westling Valve
Fast's Flexible Couplings

AMERICAN
GAS JOURNAL
Established 1859 Pioneer of the Gas Industry
Manufactured and Natural Gas

HENRY M. RILEY, *Editor*

Thermal Currency

STRICTLY SPEAKING, any utility distributing gas to a given community, regardless of whether this gas is natural, manufactured, mixed or derived as a by-product from petroleum, is supplying heat units which are ultimately put to use in carrying out some thermal operation. In other words, the utility is buying the right to the customer's patronage in this regard with thermal currency.

As a general proposition the customer is interested in having readily available heat units to cook the meal, or melt a crucible of some metal, or to carry out a thousand and one other operations where gaseous energy is employed. Consequently, he is only mildly concerned with whether such energy is supplied by one kind of gas or another. Naturally, this latter statement is contingent upon the cost factors. Admitting that this is the crux of the matter one can appreciate that the situation is rather like the storekeeper who has a certain item priced at a quarter, and who will accordingly accept payment either in five nickels or one twenty-five cent piece. He might much rather receive one twenty-five cent piece than five-nickels, or vice-versa, but it might happen that nickels are more prevalent in his part of the country. In either case he has received full payment for goods, just as 1000 B.t.u. will do a certain piece of thermal work, regardless of what kind of gas is the vehicle, so to speak.

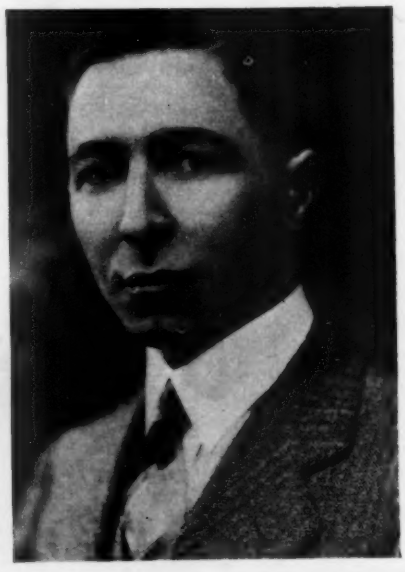
Accordingly, it would seem that in a broad sense one errs in classifying gas men as natural gas men or manufactured gas men or whatever kind of a gas man you will. We are all primarily just *gas men,* and, although some of us are able to deliver a certain number of heat units to the customer in a smaller volume than the other fellow, we each finally accomplish an identical end with these selfsame heat units.

It is to be hoped that the present Memphis Convention will be attended by gas men from all sections of the country. Assuredly they will return not better natural gas men or better manufactured gas men, but better *gas* men. After all, in buying customer patronage, we are all making purchases with the same general sort of currency.

Officers Guiding Affairs of the Natural Gas Department of American Gas Association

H. C. Cooper
Chairman, Natural Gas Department

Alexander Forward,
Managing Director, American Gas Association



E. J. Stephany,
Secretary, Natural Gas Department

R. W. Gallagher,
Vice President, American Gas Association

H. L. Montgomery,
Vice Chairman, Natural Gas Department

N. C. McGowen,
Vice-President, American Gas Association

Some Thoughts on Natural Gas

CLIFFORD E. PAIGE
President American Gas Association

DISCOVERIES of new gas and oil fields and greatly increased production of natural gas has had, and will continue for some years to have, a profound influence upon the gas industry of America. Into very large sections of the country there is now introduced a most valuable fuel whether used as the sole source of community supply or for the enrichment of other kinds of gas. This development has brought notable advances in the technique of long distance transmission and in the manufacture and installation of pipe lines. It is logical, therefore, that matters of production and of transportation have the major part of the program of the meeting of the Natural Gas Department in Memphis. It is also logical that gas mixtures and the utilization of natural and mixed gases in appliances should form such a significant part of the program of the American Gas Association Laboratory at Cleveland.

Most fortunate for both the natural gas and manufactured gas industries was the merger of the activities of the two industries in 1927 when the Natural Gas Association of America amalgamated with the American Gas Association. The resultant cooperation in research and educational work, has been timely and advantageous to each. From the natural gas industry the manufactured gas industry has received the influence of the pioneer spirit, the romance of discovery and control of a wild element of nature and its harnessing for man's use, a transfusion of new blood, so to speak; and the introduction of this richer, natural fuel has opened new fields of heating usage in both home and industry that in part were not available to the manufactured gas business. On the other hand, the natural gas man, who was mainly a producer of oil and gas, and a marketer of the latter largely in wholesale quantities or for big industrial usage, has been brought into closer contact and accord with his manufactured gas brother; he has benefitted and will continue to benefit from the years of experience of the latter in gas merchandising to industry and the home; he is profiting and will continue to profit in increasing measure from the great program of research and educational work that has been carried on for years by the American Gas Association and which will go forward with much greater impetus and effectiveness for both branches of the industry.

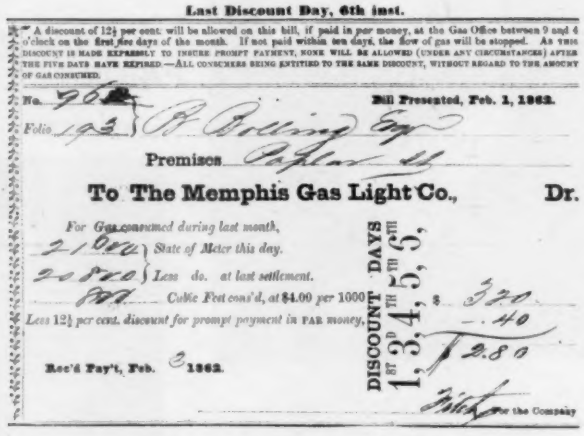
Yet this transition through which the gas industry is passing presents many puzzling problems, to which the best minds of the industry must be applied. It will mean the realignment and readjustment of the operations of at least a part of the older industry to those of the new; it will mean the utilization of the facilities for public information to protect the investor from unwise and unwarranted extensions of gas service.

The gas industry is virile, it is alive to its problems and its opportunities, and has within itself the power of discipline. It will meet these problems as it has those of the past with a spirit and a determination to solve them in the best interests of the public, its customers and its investors.

Building formerly occupied by the Memphis Power & Light Company until October, 1925.

In the Olden Time

In 1852 when the Memphis Gas Light Company was started there were but 99 other gas companies in the United States. Gas was high in price and was utilized solely for lighting. In those by-gone days Natural Gas was somewhat of a freak fuel and, at best, had but a nuisance value



Last Discount Day, 6th inst.

A discount of 12½ per cent will be allowed on this bill, if paid in per money, at the Gas Office between 9 and 4 o'clock on the first five days of the month. If not paid within ten days, the flow of gas will be stopped. As this DISCOUNT IS MADE EXPRESSLY TO INSURE PROMPT PAYMENT, NONE WILL BE ALLOWED (UNDER ANY CIRCUMSTANCES) AFTER THE FIVE DAYS HAVE EXPIRED.—ALL CONSUMERS BEING ENTITLED TO THE SAME DISCOUNT, WITHOUT REGARD TO THE AMOUNT OF GAS CONSUMED.

No. 96 Bill Presented, Feb. 1, 1862.

Folio 193 R. Boling Esq

Premises Poplar St

To The Memphis Gas Light Co., Dr.

For Gas consumed during last month,

21000 } State of Meter this day.

20800 } Less do. at last settlement.

200 Cubic Feet cons'd, at $4.00 per 1000 $ 3.20

Less 12½ per cent. discount for prompt payment in PAR money, .40

Rec'd Pay't, Feb. 6 1862. $2.80

DISCOUNT DAYS 1st 1, 2, 3, 4, 5, 6th

for the Company

Seventy years ago gas cost real money in Memphis. Specimen of an old Memphis Gas Light Company bill.

MEMPHIS, TENN., GAS-LIGHT COMPANY.

Superintendent's Office M. G. L. Co.,
Memphis, Tenn., June 18th, 1862.

To the Editor of the AMERICAN GAS-LIGHT JOURNAL:

If you can wait until our exchange becomes settled at a reasonable rate, for the amount of a subscription to your valuable GAS-LIGHT JOURNAL, you may send it immediately. I also wish to purchase several books, but will not order till our currency can be exchanged with less loss.

During the last year we have been completely cut off from all our sources of information as to what is transpiring in the gas-light world, and I would esteem it a favor if you would hand my address to some of the principal dealers in gas apparatus in your city, with a request to communicate, and send me circulars of whatever is new.

Our consumption here has greatly decreased since the unfortunate and unnecessary commencement of hostilities between the two sections of our country, but I hope we will soon be obliged to resume the extension of our works, and that matters will soon be smoothly flowing along in their accustomed channel. Please send me anything new in the way of notices of new scientific works, that you may have convenient.

Mr. A. Simister, the former superintendent of these works, who I presume has corresponded with you, died on the 30th of March last. I succeeded him immediately. Hoping to hear from you at your earliest convenience, I remain, yours very truly,

CHAS. M. HARA,
Sup't Memphis G. L. Co.

[We comply cheerfully with Mr. Hara's request by sending him the JOURNAL, and are quite content to wait for payment until the currency gets righted. ED.]

An old news item dating back to Civil War Days.

Portable Wrought Iron Family RANGE.

Monitor Range, double or single oven, burns either coal, coke or wood It is adapted to hotel, restaurant and family purposes. It is more durable and easily worked, consumes less fuel than any range or stove sold in this market. Every range sold is guaranteed to give entire satisfaction.

H. WETTER & CO

Many gas men can remember when only the above sort of ranges were advertised in Memphis and the rest of the country.

The Old Order Changes

Natural Gas bids fair to revolutionize the economic and industrial life of one of the south's greatest cities, Memphis.

Gas holder formerly used to store manufactured gas, now filled with natural gas.

New Memphis Power & Light building showing decorations during the past Christmas season.

Construction difficulties in bringing natural gas to Memphis. Diverting the bed of a river while laying pipe line.

All the buildings shown except the low structure in the foreground now use natural gas for fuel.

Steam station of Memphis Power & Light Company which uses natural gas exclusively under its boilers.

Gas Pressure Regulation

Necessity and Benefits in Modern Distribution And Utilization of Natural Gas

GEO. WEHRLE

Superintendent Gas Department, Public Service Company of Colorado

REGULATION is defined as the fact of disposing, ordering or governing by rule or system; to put or keep in good order; to adjust according to a standard, or to reduce to or maintain in order. The scope covered by this definition is so wide and so important as to make it the first principle in the conduct of the universe to which all things are subject and the failure of which is chaos.

Regulation is obviously the first requisite of service and service is the paramount object of the gas business. Therefore, in considering the subject of pressure regulation as it is related to the distribution and utilization of natural gas, we have a topic covering a wide range of utility and one of extreme importance. It will be the endeavor in these articles to avoid as much as possible a preponderance of dry technology, with which the subject is filled, but to combine theory and principle with actual experiences in such a way that a maximum amount of readable information may be imparted.

In the production, transmission, distribution and utilization of natural gas, a very wide range of pressures is encountered. Some times high pressures are decidedly advantageous but at other times may be equally disadvantageous. Since pressure is the propelling force of gas flow, there is no apparem benefit to be derived from pressures higher than the minimum requirement to deliver the amount of gas demanded to the most remote customers at all times, and this may be considered as the law of gas pressure regulation.

Regulation of gas pressures consists not only of designs of equipment but designs of methods as well. The same equipment may be used in various ways to produce vastly different economic results. A discussion of this subject cannot be confined to the regulators or governors alone but must include the system and methods used in transmitting and distributing gas, including an idea of the class of materials used and how they are used to the best advantages.

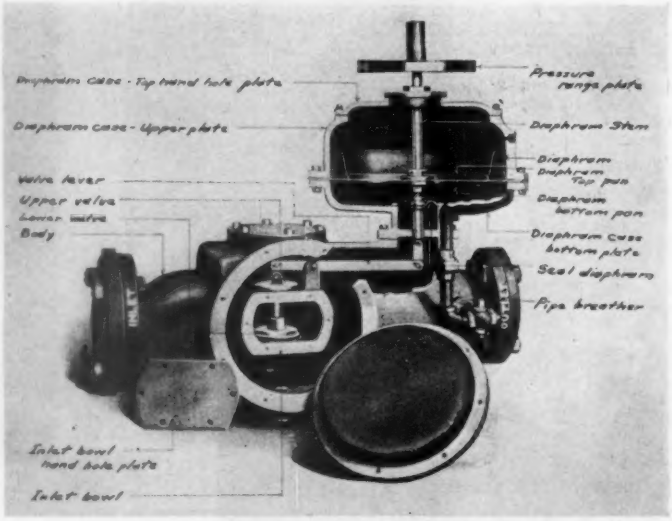


Fig. 1. Balanced valve station regulator

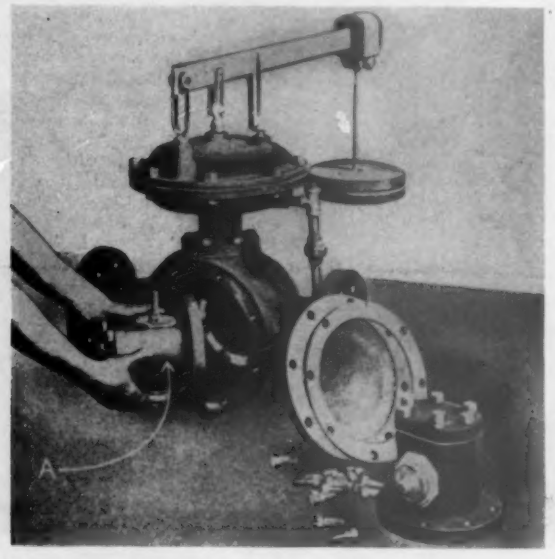


Fig. 2. Accessibility to replacement of parts

In both manufactured and natural gas use, pressure regulation is essential to effect: (1) complete and efficient combustion of the gas; (2) the maintenance of predetermined pressures for transmission of the gas effectively and efficiently; (3) accurate metering; and (4) protection against excessive stresses and strains that might damage or destroy life or property.

Evolution of Gas Pressure Regulators

In the early days of the gas business, pressures were controlled by means of crude, manually-operated valves, or by inserting a solid block in the pipe containing a small aperture, the size of which depended upon the amount of pressure reduction required. With constant inlet pressure and a constant volume demand, the pressure reduction followed the well-known law, $P_1V_1 = P_0V_0$. When the inlet pressure changed or the volume demand changed, the pressure at the outlet of the reducing device also changed, necessitating an adjustment of the valve or the replacing of the aperture plug with one of different size.

Some one then conceived the idea of utilizing the principle of the gasometer in producing constant outlet pressures with varying flows. The bell of the gasometer

floated in a tank of water and was fastened to a rod manipulating a suitable valve which was free to close and open as the bell of the governor rose and fell. A small pipe connected from the outlet pipe to the bell. Sufficient weight was placed upon the bell to transmit the desired pressure. As the volume of gas flowing through the governor increased or decreased, the pressure underneath the bell decreasd or increased, causing the bell to fall or rise and the valve to open or close, thus restoring the outlet pressure equilibrium. Naturally, this crude governing device was suitable only for low pressures and small variations of flow or pressure so that the next step was the substitution of mercury for the water seal. This allowed higher pressures to be used, and, since this type of governor was more properly proportioned and constructed, allowed greater variation in the volume of gas flowing. This governor was quite satisfactory and was capable of automatically handling demands over a moderate range. A number are still seen in every-day operation, chiefly as station governors in small gas-manufacturing plants.

The increased use of gas in industry and in residences called for governors or regulators to handle higher pressures and for a wider use of regulators for varied purposes, resulting in the diaphragm and balanced-valve types now generally used. It is now possible to obtain regulators capable of reducing inlet pressures from 500 pounds to 5 pounds, or from 100 pounds to 2 ounces, and by the proper selection of regulators to obtain any desired degree of regulation from 1000 pounds down.

Gas Regulators

A pressure regulator is an automatic mechanism constructed to counteract any force that tends to increase or decrease the outlet pressure beyond a predetermined margin.

The underlying principles of operation of regulators are very old. On one side of a flexible, movable disc, called the diaphragm, is the controlled pressure. On the other side of the diaphragm is the counteracting force applied either by a weight or a spring. The diaphragm is connected with valves which restrict the flow of gas either directly through a diaphragm stem or through a lever system. When the pressure in the line changes, the diaphragm moves the valves until the forces on both sides of the diaphragm balance.

In the operation of a regulator, the controlled pressure is admitted beneath the diaphragm through a small pipe from the outlet of the regulator. The weight on the top side of the diaphragm acts directly against this pressure. The stem attached to the diaphragm moves the valves up or down as the diaphragm moves. Thus, if the outlet pressure increases, the diaphragm raises the weight above it, and in the same action moves the valves, thereby restricting the flow. In the same manner as the pressure on the outlet side decreases, the weight above forces the diaphragm downward, opens the valves, and allows more gas to pass through from the inlet side, maintaining uniform pressure. In a sensitive regulator, the action outlined above occurs almost instantaneously, producing a steady uniform outlet pressure as recorded on the chart shown in Fig. 3.

In the design of an ideal pressure regulator, many factors beyond the general theory sketched above control its final form. For example, the size of the diaphragm and the materials from which it is made are governed by the range of outlet pressures and the accuracy of control desired, plus the ease of inspection, servicing and repairing. If the outlet pressure to be maintained is high, the diaphragm material must be flexible to allow free movement and, in addition, it must be strong enough to withstand the maximum pressure. The diaphragm area selected in this case would be small. On the other hand, if the controlled pressure is to be low, a much lighter and more flexible diaphragm material would be used. To make the regulator more sensitive to small changes of outlet pressure, a larger diaphragm is used for lower pressures. Where the degree of accuracy of controlled pressure is paramount, as exists in cases of combustion, the size and kind of materials for diaphragms must be carefully selected to satisfy any narrow margin of regulation that might be required.

The size of the valve is governed by the volume demands while the selection of valve material is governed by a number of factors, such as, line pressure, conditions of the gas, degree of shut-off desired, drop across the regulator, etc. As in the case of the design of the diaphragm, the design of the valves may be governed by the degree of accuracy of the controlled pressure and volume to be desired.

Ease of inspection, facility of servicing and quickness in effecting repairs also greatly influence the design of valves, valve orifices, and diaphragm cases. The dependence of proper design upon these factors can be appreciated better when it is realized that the valve, valve seat, and diaphragm, the vital parts of any regulator, are subject to incessant wear and deterioration by friction, abrasion, and chemical action of the gases.

The importance of selecting a type of regulator best suited to perform the work required cannot be overestimated. The careful consideration of function, design, and equipment results in dividends of economy and satisfaction not otherwise obtained.

The high-pressre balanced-valve regulator passes its maximum volume when the valves are raised to their wide-open position. Under these conditions, the well-

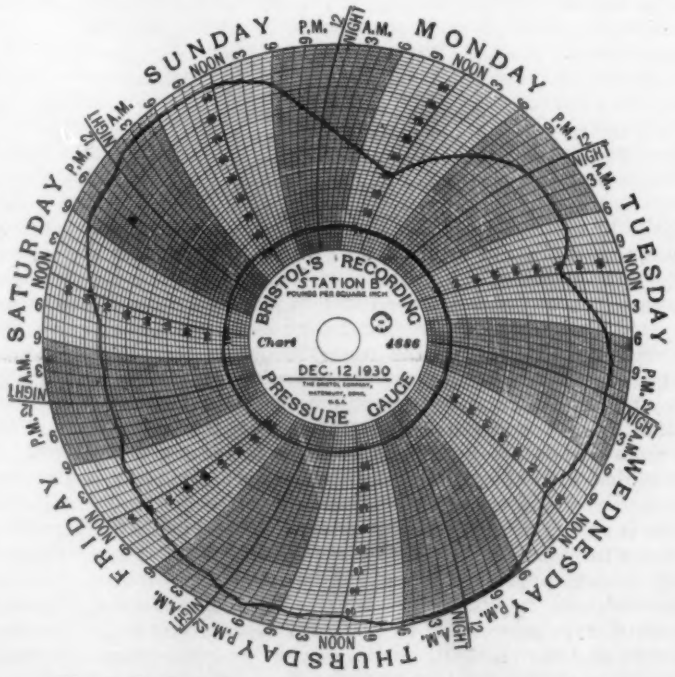


Fig. 3. Typical chart showing weekly pressure regulation

known flow formula applies and is expressed as follows:

$Q = K_H\sqrt{P_oH}$ where

Q = Number of cubic feet per hour at a base pressure of 4 oz.

P_o = Absolute outlet pressure in pounds per square inch

h = Drop in pressure in inches of water

K_H = A constant depending on the size of the regulator valve openings and is determined experimentally for each size

The preceding formula applies below the critical or acoustic velocity of the gas and is used in computing the table of capacities in that range. If the ratio of the outlet pressure absolute to the inlet pressure absolute is less than .528, the gas has reached its maximum velocity and cannot be made to move any faster, and what is termed the critical velocity has been reached. Although the gas cannot be made to move at a greater velocity, the actual weight of gas moving can be increased by increasing the density of the gas as it passes through the minimum restriction.

When P_o is greater than .528 P_I, the formula to use is $Q = K_H\sqrt{P_oh}$, which gives the volume in cubic feet per hour at 4 oz. pressure base. When P_o is less than .528 P_I, the formula to use is $Q = .5K_HP_I = K_{CH}P_I$, which gives the volume in cubic feet per hour at 4 oz. pressure base. The critical velocity is reached when $P_o = .528\ P_I$.

Town Border Station Equipment

It is assumed that the principal use of gas pressure regulators begins at the town border station where gas is delivered from the pipe line to the distribution system. Since the pipe line acts as a storage system, as well as a means of transmitting gas from the well to the customer, pressures are usually carried considerably higher than is necessary to observe the simple law of pressure regulation. In all but the smaller pipe lines, pressure boosting rather than pressure reducing is the paramount problem ahead of the town border station.

At the town border station, gas is delivered to the distribution system through a pressure regulator into the transmission mains. The pressure at which the gas is delivered at the outlet of the regulator is usually fixed by the contract between the pipe line and distributing companies. This guaranteed delivery pressure usually does not exceed 50 pounds. The gas is measured at this point and proper correction for pressure and temperature applied.

While gas may be transmitted by the distributing company to district regulators or direct to customers at the same pressure as it is received from the pipe line company, sometimes a second step in pressure reduction is used, in which case the distributing company operates a regulator succeeding the town border meter. This regulator may be located at the town border station or at another location. In small towns, advantage is often taken of the relatively high pipe-line delivery pressure to reduce pipe sizes to the distribution center, in which case the distribution company's regulator is located at the distribution center.

It is customary in large town border regulator installations to install the regulators in parallel. This is usually done to provide standby equipment in case of trouble with the regulator operating. The careful selection of regulator sizes to conform with volume demands and the changing of diaphragm or valve assemblies to meet seasonal or varied volume demands will improve regulation.

Since the expansion of gas passing through the regulator absorbs heat from the surrounding atmosphere, care must be exercised to prevent regulators freezing when the pressure reduction is great. Sometimes heat is applied to the flowing gas, and at other times the use of two or more stages of pressure reduction is found advantageous. The latter method is more frequently used in small installations where the application of heat would be impractical or uneconomical. While certain engineers are working on the problem of determining a formula to use in establishing a relation between pressure reduction and temperature applying, at this time the information is not available. From personal experience in the latitude of Denver, we find it advisable to protect installations against freezing if the reduction exceeds 150 pounds in winter-time, even though the gas shows no trace of moisture in ordinary humidity tests.

District Regulators

District regulators are identical in function and design to the regulators used at the town border station. The pressure reduction under which district regulators operate is usually from a maximum inlet pressure of 50 pounds to a maximum outlet pressure of two or three pounds. Usually, the outlet pressure is computed in ounces or inches of water column.

Where district regulators are used, a high-pressure or intermediate-pressure main system transmits the gas from the town border station to the various distribution centers where it is delivered to the so-called low-pressure distribution system. In these articles, high pressures are assumed to be pressures exceeding 15 pounds, intermediate pressures are assumed to be those between 3 pounds (81 inches water column) and 15 pounds, and low pressures are assumed to be all pressures below 81 inches water column. Pressure reduction through district regulators may be either from high pressure to low pressure, without an intermediate step, or from intermediate pressure to low pressure. The same type of regulator, of proper design to suit pressure and volume conditions, may be used.

The number of district regulators in a given situation depends upon the design of the distribution system or distribution pressures used. If very low distribution pressures are used, a greater number of district regulators will be required since the low distribution pressures allow very little, if any, loss between the regulating station and the customer's appliance, therefore, the stations must be located at frequent intervals. If distribution pressures are high enough to allow for a considerable conductivity loss in the mains, the number of district regulating stations needed will be reduced very materially.

Descriptions of designs of various distribution systems and the relative effect upon the use of regulators are given in a succeeding article.

Service Regulators

Service regulators are used to reduce high or varying distribution pressures to a uniform and efficient utilization pressure at appliances. These regulators may be designed to reduce high or intermediate pressures to approximately a few ounces or inches of utilization pressure or the reduction may be from ounces or inches to a lower value of ounces or inches. The customary utilization pressure at domestic appliances is from 2½ to 4 ounces (4 to 6½ inches water column),

although certain commercial and industrial appliances may be served at higher pressures.

The use of service regulators depends largely upon the design of the distribution system and the range of pressures carried thereon. It is customary to install service regulators when pressures on the distribution mains exceed 8 ounces (13½ inches water column), or when pressure variations from low to high exceed 100 per cent. It is obvious that pressures at the point of metering affect the true registration of gas actually consumed at atmospheric pressure and that the pressure at the meter should be as low as possible consistent with good service. The ratio of 4-ounce and 8-ounce gage pressure under standard conditions of atmospheric pressure is 1.017. Under these conditions, at 8-ounce gage pressure, the meter passes 1.7 per cent more gas than it does at 4-ounce gage pressure. It is found that efficiency of utilization is affected when pressures exceed 8 ounces on ordinary appliances or when pressures at the appliance vary more than 100 per cent, without readjustment.

(*Continued in June Issue*)

Natural Gas Aids in Sand Production

E. H. FISHER

Engineer, Coast Industrial Gas Company

THE past year has seen the establishments of a number of new industries in Contra Costa County, California, and the service of straight natural gas, which is now available there, has played an important part in this development.

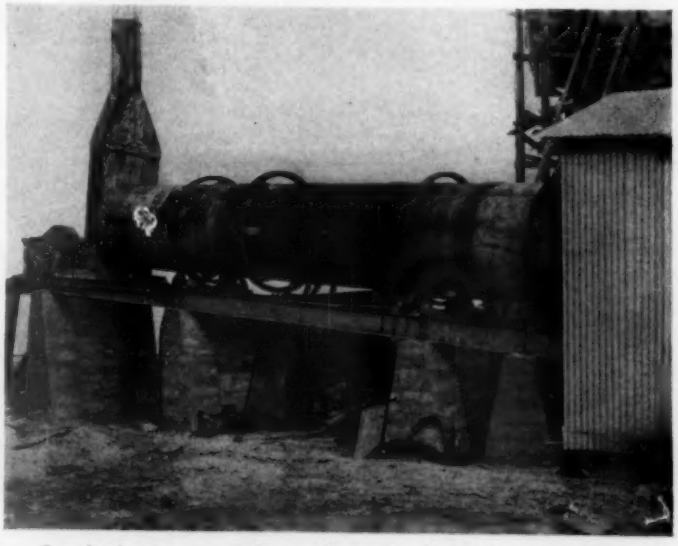
Among the most interesting of the new industries is the plant of the Silica Company of California Ltd., which has been built for the purpose of producing foundry and glass sands. Their development program has resulted in the perfection of new methods and the use of new equipment. Natural Gas has been an important factor in this development, and has done much to aid in both the methods and the low cost of production which has made this work possible

The raw sand is obtained from open pits located about four miles from the plant and hauled by means of trucks to the grading machinery. In this unit the sand is washed, and screened, producing a product highly satisfactory for use in foundry work. However, before the sand can be used for the making of glass, it is necessary that the iron content be removed, that is, the non-magnetic or chemically combined iron, and this is the most difficult part of all.

Here the use of natural gas comes into play, as it is used to fire a rotary type drier which is used to remove the moisture after the sand has been taken from the grader.

This particular drying process differs from the conventional, in that the outlet temperature of the sand must be approximately 400° Fahrenheit. The reason for that is that the iron is removed from the sand by bleaching tanks of acid and all of the heat necessary to raise and maintain the mixture at boiling temperature is supplied by hot sand as it comes from the drier. Other agents, known only to the Silica Company, are added to assist in removal of iron.

When the installation of gas for this drier was first contemplated, the question arose as to whether the desired capacity could be obtained from the drier without some form of forced draft and difficulty was at first



Gas fired rotary sand dryer. Four No. 11 N. G. E. burners are located inside the building at the lower end of the dryer.

experienced in obtaining sufficient air to completely burn the gas in the seven foot combustion chamber.

However, very satisfactory combustion was secured by engineers of Coast Industrial Gas Company through the use of four No. 11 N. G. E. burners with very small orifices and a gas pressure of about 15 pounds.

The firing of the steam shovel used in the yard is also accomplished by the utilization of natural gas, which is supplied through about 100 feet of 1½" rubber hose which may be connected at conveniently located taps throughout the yard.

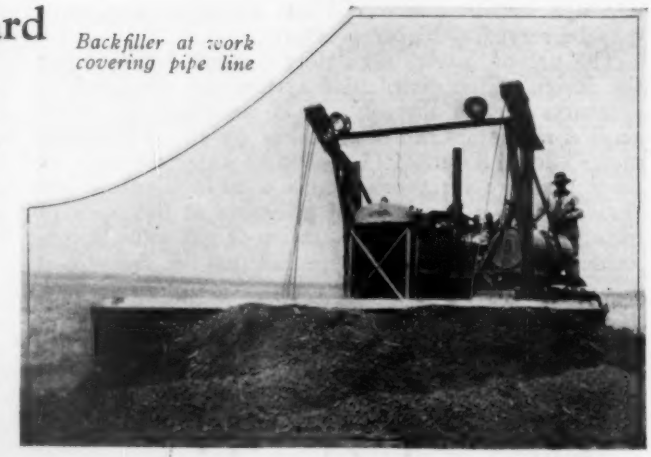
Under the old method of using coal as fuel, difficulties were encountered due to the limited combustion space and the desire of the operators to maintain steam pressure while operating the engines and the water injector at the same time.

With gas, through the use of a No. 10 N. G. E burner and a Wilgus gas fuel regulator, they are able to maintain a very constant steam pressure, and the operator is able to run the shovel without the aid of a fireman due to the elimination of a great deal of work formerly involved in manual control of steam pressure and stoking of the coal fires.

The plant as first established by the Silica Company of California, Ltd. is being increased in capacity, this being due to the fact that during the past year it has been successfully proved that the sand now being produced, through the use of these new processes and methods, can be used for the making of a very fine quality glass at a satisfactorily low cost.

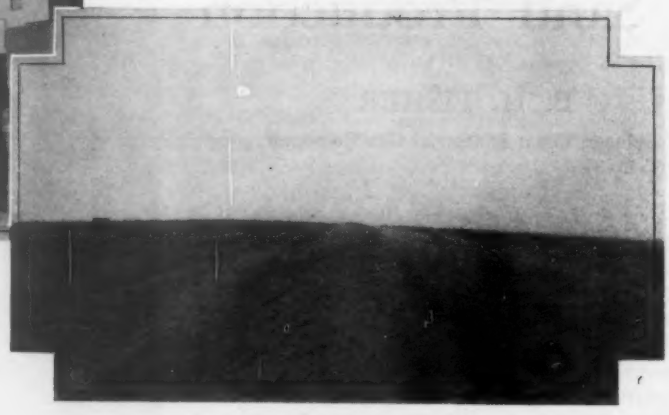
Natural Gas Heads Chicagoward

The Natural Gas line to Chicago runs from the Texas Panhandle fields, a distance of approximately 950 miles. Along the line will be ten compressor stations. When Natural Gas, to the extent of approximately 175,000,000 cu. ft. per day, enters Chicago about September 1st. this city will constitute the greatest single utility user of this remarkable fuel.



Backfiller at work covering pipe line

Above—stringing eight twenty-four inch pipe joints



Right—Completed back-fill

Grading right-of-way before ditching

Arkansas River crossing under construction

Applying corrosion protecting coating to eighty foot joint of 24" pipe

Every producing oil well in Texas, and there are nearly 40,000, contributes to the daily waste of natural gas

Texas Moves to Curb Gas Waste

Daily Loss From Producing Oil Wells Sufficient to Fulfill Requirements Of 500,000 People For 45 Days

B. C. REBER

EVERY twenty-four hours sufficient natural gas is being wasted by Texas' 37,395 producing oil wells to sustain the domestic and industrial requirements of half a million people through a period of forty-five days. This daily waste of 1,057,315,501 cubic feet is slightly more than half the total daily gas production from these wells, and, for one week is equivalent to the combined demands of one of the large utility companies of Texas for the entire year 1930.

Aroused by this flagrant abuse of one of its chief natural resources, the State of Texas, through its Railroad Commission, is taking active steps to remedy the condition. This work is being carried on under the direction of R. D. Parker, Chief Supervisor of the Oil and Gas Division of the Railroad Commission, assisted by Leslie McKay, Chief Deputy Supervisor. A crew of seventeen field men or "conservation agents" send in daily reports on their activities which are supplemented by reports from each of the producing companies. These duties will be covered in more detail in another part of this article.

To get to the beginning of gas conservation in Texas, it is necessary to go back to the year 1919 when a law was passed by the 36th session of the Legislature tending to regulate the waste of this product. At that time, however, Texas had not developed the present enormous oil and gas producing territories and little interest was placed in this legislation at that time.

Influence of Oil Production

There is another element which contributes to the waste of gas and that is the production of oil. This latter commodity, having a higher sales value than gas, has been the object of first consideration in all developments undertaken in this industry. It is only within recent years that operators have given any attention to the enormous waste connected with the production of oil and have been interested in developing plans to prevent this waste.

During the latter part of 1929, considerable public criticism had been aroused because of the wanton waste of natural gas and the Railroad Commission began a hurried examination of existing Statutes to determine what could be done about it.

In 1925, in the Revised Civil Statutes, there are three articles dealing with the waste of natural gas coming from producing oil wells. Article 6008, Revised Civil Statutes, 1925, in its pertinent part, is as follows:

"Any persons . . . in possession . . . of any well producing natural gas, in order to prevent the said gas from wasting by escape, shall within ten days after penetrating the gas bearing rock in any well, shut in and confine the gas in said well until and during such time as the gas within it be utilized for light, fuel or power; provided that this shall not apply to any well that is operated for oil. . . ."

The final phrase in this article—" . . . provided that this shall not apply to any well that is operated for oil. . . ."—has been the joker which has resulted in such an enormous waste; for, where oil has been given the preference in all drilling operations, it has been possible to operate a well producing only ten or fifteen barrels of oil daily, against ten to twenty million feet of gas, without interference from the Railroad Commission through the phraseology of this Statute.

There is, however, another article which tends to cover this condition, and it is on an interpretation of this article that the commission hopes to become empowered with sufficient authority to exercise control over this loss. The article in question is Article 6014, Revised Civil Statutes, 1925, and its applicable portion is as follows:

"Neither natural nor crude petroleum shall be produced, transported, stored or used in such manner or under such conditions as to constitute waste; provided, however, this shall not be construed to mean economic waste. The term 'waste' in addition to its ordinary meaning, shall include permitting (a) escape into the open air of natural gas except as may be necessary in the drilling or operation of a well; . . . ."

Such a condition has been found to actually exist among all the oil fields in operation. The daily waste

of raw gas, in addition to that required for the drilling or operation of a well, is 461,753,000 cubic feet; and the daily waste of residue, or casing-head gas, is 595,562,501 cubic feet. It is such losses that the Commission is endeavoring to curb.

Interpretation of Statutes

First definite action on the part of the Railroad Commission was during the latter part of 1929 when an opinion was sought from the Attorney General seeking a correct interpretation of the Statutes, as well as to what extent the Commission might proceed. This opinion was handed down on December 6, 1929, and may be summarized, briefly, as follows:

1. Oil and Gas—Natural gas cannot be produced from wells not operated for oil except for use as light, fuel and power.

2. Constitutional Law—Article 6008, Revised Civil Statutes, 1925, held constitutional.

3. Construction of Statutes—Article 6008 construed not to apply to natural gas produced from a well found as a question of fact to be operated for oil.

4. Oil and Gas—Authority of Railroad Commission—Railroad Commission has no authority to require that gas produced from a well operated in fact for oil be shut in and confined until used for light, fuel and power purposes.

5. Construction of Statutes—Authority of Railroad Commission—The Railroad Commission has authority under Article 6014 to prevent the escape into open air of natural gas produced from a well operated for the production of oil, except such amount thereof as may be necessary in the drilling and operation of such well.

In addition to seeking a true interpretation of the Statutes, and in order to have some definite knowledge on which to base their claims, a survey of the field was ordered. This survey, completed October 31, 1930, brought forth some startling facts. This report is made a part of this article and may be referred to from time to time as the article continues.

Some Examples of Waste

At this time, however, it is well to point out some of the outstanding examples of waste. In the San Angelo District, practically the entire production of 108,608,000 cubic feet of gas is wasted to produce 23,218 barrels of

PRODUCTION REPORT ALL OIL WELLS IN TEXAS AND

Districts	Number of prod. oil wells	Av. daily prod. oil, all wells	Cu. ft. gas daily all oil wells	Gas-oil ratio cu. ft. gas to bbl.	Cu. ft. raw gas wasted
Austin No. 1	641	10,888	3,700,000	340	2,950,000
San Antonio No. 2	3,600	70,069	32,390,000	462	29,000,000
Houston No. 3	1,037	68,197	24,129,000	354	2,101,000
Beaumont No. 4	1,693	62,750	18,786,000	300	1,500,000
Dallas No. 5	2,326	37,554	10,376,000	276	.....
Eastland No. 6	1,344	4,681	46,867,000	10,012	4,146,000
Cisco No. 7	4,883	13,756	75,143,000	5,462	605,000
Coleman No. 8	2,390	7,238	14,398,000	1,975	.....
Midland No. 9	1,042	72,705	63,748,000	879	48,098,000
Olney No. 10	3,925	27,000	33,877,000	1,254	5,000,000
Wichita Falls No. 11	4,148	18,544	7,928,501	427	.....
Electra No. 12	5,784	31,724	8,919,000	281	.....
Amarillo No. 13	890	22,305	594,017,000	29,450	55,475,000
San Angelo No. 14	301	23,218	108,680,000	4,250	.....
Laredo No. 15	1,111	42,433	201,479,000	4,771	183,125,000
Pampa No. 16	1,008	62,994	656,678,000	9,771	50,000,000
Ft. Stockton No. 17	1,117	137,315	140,306,000	1,023	79,753,000
Tyler No. 18	155	3,068	4,187,000	1,364	.....
Totals	37,395	716,439	2.045,808,501	.....	461,753,000

Below is a statement of the number of high pressure or straight gas wells in Texas, the average DAILY OPEN FLOW CAPACITY and the TOTAL WITHDRAWALS for year ending October 31, 1930.

Number of gas wells in Texas	Average Daily Open Flow capacity—Cubic Feet	Total Withdrawals for year—Cubic Feet
2,001	20,049,249,000	215,857,368,000

Report of the consumption of gas in Texas for the year ending December 31, 1929, showing the number of meters and the gas consumption in each class of service.

No. Domestic Meters	No. Industrial Meters	Cu. Ft. Dom. Gas used	Cu. Ft. Ind. Gas used	Cu. Ft. Field & Misc. gas used	Total No. of Meters All Purposes	Total Cu. Ft. Gas used for all purposes
490,714	11,232	39,943,196,000	127,445,447,000	18,428,395,000	501,946	185,817,038,000

Daily amount of gas from straight gas wells exported and imported, October 31, 1930.

Exported

Canadian River Gas Co.	32,985,000	Colorado
Cities Service Gas Co.	85,000,000	Kansas
Consolidated Gas U. Co.	17,500,000	Oklahoma
South Plains Gas Co.	414,000	New Mexico
Public Service Corp. of Texas	90,000	Oklahoma
Texas-Louisiana Power Co.	3,066,000	Oklahoma
South Texas Gas Co.	4,986,000	Monterrey, Mexico
Texas Border Gas Co.	363,000	Nuevo Laredo, Mexico
Reserve Nat'l Gas Co.	8,447,000	Louisiana
Lone Star Gas Co.	1,049,266	Oklahoma
Total	156 900,266	

Imported

El Paso Natural Gas Co.	18,000,000	New Mexico
United Pipe Line Co.	40,000,000	Louisiana
Arkansas-Louisiana P. L. Co.	36,000,000	Louisiana
Lone Star Gas Co.	7,711,466	Oklahoma
Total	01,711,466	

oil. In the Amarillo District, 275,421,000 cubic feet, or nearly half of the daily production of 594,017,000 cubic feet is wasted to produce 22,305 barrels. In the Laredo District, approximately nine-tenths of the daily production of 201,479,000 cubic feet of gas is wasted to produce 42,433 barrels. The Pampa District is also shown, by reference to the report, to contribute largely to the waste.

It is in the San Angelo District that a number of wells have been drilled on State property, and it is in the Big Lake field, a portion of this district, that agitation was first aroused.

With an interpretation of the existing Statutes from the Attorney General, and definite figures as the result of this survey, the Commission began an active campaign for improvement. In the Laredo District the operators were induced to install choke valves which have assisted in cutting down the waste of gas to some extent.

In the San Angelo District the operators have installed steel tubing in some of the wells with some satisfactory results.

There are, however, a number of elements which enter into attaining the desired results in all instances.

DISPOSITION OF CASINGHEAD GAS OCTOBER 31, 1930.

Raw gas used for fuel and lease purposes	Cu. ft. gas into casinghead plant	Cu. ft. residue gas wasted	Cu. ft. residue gas used on lease	Cu. ft. residue gas for domestic and ind. fuel	Cu. ft. residue to carbon plants
650,000	100,000	.....	100,000	.....	.....
890,000	2,500,000	72,000	2,356,000	72,000	.....
22,028,000	No casinghead plants	.....	.....	.....	.....
17,286,000	No casinghead plants	.....	.....	.....	.....
.....	10,376,000	1,800,000	8,294,000	282,000	.....
3,958,000	38,763,000	499,000	8,417,000	26,160,000	3,687,000
880,000	73,658,000	343,000	17,311,000	42,146,000	13,858,000
.....	14,398,000	400,000	5,398,000	7,400,000	1,200,000
12,050,000	3,600,000	1,100,000	2,500,000	.....	.....
15,000,000	13,877,000	1,836,000	6,922,000	4,219,000	900,000
1,292,000	6,636,501	336,501	2,300,000	4,000,000	.....
125,000	8,794,000	.....	3,047,000	5,747,000	.....
.....	538,542,000	219,946,000	105,048,000	.....	213,548,000
.....	108,680,000	108,580,000	100,000	.....	.....
18,354,000	No casinghead plants	.....	.....	.....	.....
None	606,678,000	224,604,000	131,890,000	.....	250,184,000
18,753,000	42,000,000	35,900,000	6,100,000	.....	.....
.....	4,187,000	146,000	1,629,000	2,412,000	.....
111,266,000	1,472,789,501	595,562,501	301,412,000	92,438,000	483,377,000

The back pressure on some wells has had to be considered. Another factor that has exerted a powerful influence is the fact that, should the operators take steps to conserve this gas, they would find no market for it. Domestic and industrial gas consumption in practically all the communities in Texas is under franchise to several of the large operating utility companies. These companies are under contract with certain gas producing operators to take over their supply of natural gas. This supply in all instances is sufficient to meet all requirements. In fact, there are several good wells producing only natural gas that are shut down at this time, since their is no market for the gas.

A bill was introduced before the 41st session of the Legislature in 1929, which would have given the Railroad Commission power to shut down any oil well which had not provided a market for its natural gas in excess of that which was used in the drilling or operation of the well. This bill was successfully defeated through the vigorous opposition of the independent operators. It is worth noting that they were entirely sincere in their intentions, for passage of such a bill would practically legislate them out of business.

For the purposes of illustration, let us assume that in a large field one of the major producing companies has brought in several wells that are both oil and gas producers. Through the connections that this firm has established, it is able to sell its gas to several utility companies operating near that field, and the oil always has a ready market. Consequently, both oil and gas are produced and sold.

Adjacent to the property leased by the major producing company, an independent operator has a few acres, and drills a well. He brings in a well producing, say, 1,000 barrels of oil and 40,000,000 cubic feet of gas daily. He experiences no trouble in taking care of the oil. With the gas, however, it is different. The utility companies are tied up with contracts with the major producing companies. They have more than the amount of gas they require. There is no market for the independent producer's gas. Consequently, if he were compelled to find a market for his gas as well as his oil, he would be compelled to shut down altogether.

Through the interpretation of article 6014, the Railroad Commission took preliminary steps to curb some of the waste in the Amarillo District, where the gas-oil ratio is the highest in the state, namely, 29,450. Anticipating such a move, one of the producing companies operating in this field filed suit for an injunction, seeking to prevent the Railroad Commission from taking any steps which would hamper their operations. The suit is styled the T. M. Deal Oil and Gas Company vs. Railroad Commission of the State of Texas. This case has not yet been brought to trial, and considerable interest is being shown in it. Should decision be handed down in favor of the Railroad Commission, the Commission would then be vested with the necessary power to immediately take such steps as it deemed essential to prevent the waste of all natural gas coming from oil wells except such as would be required for the drilling and operation of the wells. If, however, the decision should be in favor of the plaintiff, then the commission's hands would be tied, and practically nothing in a legal way could be done. In the mean time the daily waste of more than a billion cubic feet of natural gas goes on.

Lack of more legislation has hampered the Commission in its efforts, and much that has been accomplished during the past year has been through missionary work on the part of the conservation agents and the cooperative attitude of the major operating companies. The change toward a desire to curb this great waste of gas during the past five years by the major operating companies has done much to remedy conditions where

legislation would only have resulted in injunctions, litigations, appeals and continued cases.

Some gasoline cracking plants and carbon black plants have been established, but with the current business depression, there has been such a small market for carbon black, that there has been no necessity for erecting additional plants.

One of the large gas companies in the State is now building a 12-inch pipe line into the San Angelo District which will go a long way toward eliminating the waste in the Big Lake field. It would be foolhardy to expect that other similar lines might be constructed to take off the excess gas. For, as previously stated, there are many good gas wells now shut off for lack of a market for the product; major operators would use only the excess gas from their own wells, leaving a large portion of the daily waste which comes from the independent operators still going on.

Some relief is seen in the proration of oil production which is now being put into effect. For, if less oil is produced, it is evident that there will be a resultant lower production of natural gas. Such relief, however, will only be of a temporary nature, for as soon as there is an increased demand for oil, and the companies are permitted to increase their production, the oil wells will produce more oil, and the gas waste will be increased. About the only effective solution at the present time rests in a favorable court decision for the Railroad Commission in the case mentioned. It is probable that such a decision would be carried from the District Court to the Court of Civil Appeals, and from there to the Supreme Court before becoming final and effective. This would require several months, if not years, and in the meantime the daily waste of natural gas from oil wells in Texas is 1,057,315,501 cubic feet.

A Telling Point

LeRoy M. Edwards, General Counsel, Southern Counties Gas Company of California, Defends Right of Utility to Merchandise Appliances

The following portion of the argument made by Mr. Edwards before the Public Utilities Committee of the California State Senate appears in the complete argument under the caption, "The proposed legislation would deprive the utilities of the principal medium through which their business is developed." For the sake of brevity some of the references to electric appliances have been omitted from this item. It is noteworthy that Mr. Edwards' splendid argument was instrumental in having the proposed anti-utility merchandising bill, known as Senate Bill (Inman) No. 275, killed.—Editor.

NEITHER gas nor electricity can be delivered at the customer's back door like meat, ice or groceries, or the other commodities of common consumption. Gas and electricity can only be sold to a consumer who is equipped with appliances which can be operated by gas or electricity. The market for this type of utility service is one which must be created and developed by salesmanship. The prospective consumers must first be sold with the idea that a saving in time, money or convenience can be accomplished through the use of gas or electricity. Necessarily he must be sold a type of appliance which will best meet not only his particular needs but will stimulate in him the desire to make a further and greater use of gas or electricity in the future. No one who is inclined to be fair can deny the fact that the present high standard of utility service and the low rates now enjoyed, are due primarily to the large volume of business which has been created by the utlilities during the past twenty years. The utilities can not continue to grow and to discharge their duty of furnishing to the people the highest type of service at the lowest reasonable rates unless they are permitted to increase the volume of their business. The volume of business of these utilities can only be increased through the creation of additional consumer demand.

Who is best equipped to carry on this work? Unquestionably the utilities. Is there anyone else who can carry on this necessary work except the utilities themselves? We claim that experience has proven there is not.

In the first place, the best work of any kind is always done by the person who has the greatest incentive. The very life of the utilities depends upon building up the volume of their sales. The outside tradesman is engaged in many lines of endeavor. He is rarely interested in pushing any particular line of merchandise. The average merchant is often not successful, largely because he lacks the initiative to aggressively go after and develop business. Seldom has he either the inclination or the capital to pioneer. He will handle established lines, but he is naturally opposed to risking his time or capital in promoting new appliances. Seldom if ever will he take the trouble to urge the manufacturer to produce a better article.

The appliances which today are employed for the utilization of gas or electricity, have, in nearly every instance, not only been developed by the gas and electrical industry, but the pioneering work of educating and inducing the public to accept and use these appliances has been carried on almost exclusively by the utilities themselves—a work which has entailed a tremendous expenditure, energy and capital.

Today the gas stove is a staple commodity. Not many years ago the gas companies practically gave them away in order to induce people to even try the appliance. The appliance that is modern today may soon become old-fashioned or obsolete. New improvements are constantly being brought forward. New appliances are invented yearly. The convenience of the public and the development of the utilities require that these new and improved appliances be utilized by the public. No one but the utilities will ever take the time or spend the money necessary to place these new or improved appliances with the consuming public.

The gas and electric utilities in Southern California which I represent in this proceeding spend hundreds of thousands of dollars annually in advertising in the newspapers, magazines and billboards, new and improved types of gas and electric appliances. These companies are spending this year in excess of $500,000 for this

type of promotional work. The Pacific Gas and Electric Company will spend this year an additional $500,000 for promotional advertising, and the Electric Bureau a further $70,000. We question whether local retail dealers in gas or electric appliances will spend one-one-hundreth of this sum in advertising any type of gas or electric appliance. We are presenting to you today the types of advertising which the utilities of California are putting before the public. You will notice that in every instance they urge the consuming public to obtain these appliances through their local dealers. There is no attempt made upon the part of the utilities to secure exclusively for themselves the sales of these appliances. Such an advertising policy is manifestly most fair, and is of great value to the local dealer.

The experience of the Southern Counties Gas Company of California is that less than 20 per cent. of the gas appliances supplied in the territory served by it are purchased from the gas company—the rest is supplied by the local dealers. For example, in the Santa Monica Bay District, this utility sold, in 1930, only 18 per cent. of the gas water-heaters installed; in Pomona, 11 per cent. of the water heaters, and 13 per cent. of the gas stoves; in Santa Barbara, 14.6 per cent. of the water heaters.

The proponents of the pending legislation recognize the value of the pioneer work done in the past by the utilities, but they feel that most homes are now fully equipped with gas and electric appliances, and that the local dealers can now be left to carry on the sales work alone. This is not a correct statement of existing conditions. There still remains an enormous amount of pioneering work to be done.

The natural gas industry in California has a particularly difficult problem. In wintertime when the homes of Southern California are largely heated by gas appliances, the peak demand on cold days for gas is very great, exceeding the summer demand three and four times in amount. The gas companies, however, have to build facilities and contract for supplies of gas to take care of these peak demands, even if they exist but for a single day. Manifestly the gas utilities have to exert a tremendous effort to find and develop a market for their surplus gas during the remainder of the year; otherwise, the cost of gas would be unreasonably high. To develop this demand for gas, the utilities make an intensive survey constantly to ascertain every possible use for gas as a fuel. Their engineers study the problems of all classes of industries in order to devise types of appliances that will suit the needs of these industries, and enable them to use gas as a fuel. As a rule there is not available on the market carried by any dealer or appliance house, burners or equipment suitable for the use of most of these industries. The gas companies in their research laboratories have to design and build types of burners and equipment for the use of these industries, install them, service them, improve them, and at great expense ultimately perfect appliances that are attractive and useful. This is a type of pioneering work that no one else but the utility could do or could afford to do. It is work that is of extreme benefit to industries, and it results in benefit to all gas consumers through the utilization of gas during the off season periods, making possible lower rates to the domestic consumer for the entire year.

The Southern Counties Gas Company of California, supplying all of the communities in Orange County, Ventura County, Santa Barbara County, and most of the suburban territory in Los Angeles County, has in the past ten years done a vast amount of this pioneer work, inducing scores of industries to utilize gas who had never before even contemplated the advantages of such a fuel. The present Bill, if enacted, would put a stop to this great work.

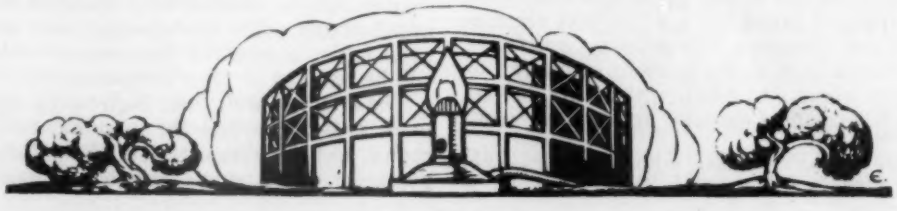
Let us give you an example of the kind of work we have done and must continue to do. Down in Southern California large amounts of chili peppers are grown. Not many years ago these were prepared for market consumption by drying in the sun, a slow and unsatisfactory process. The engineers of the Southern Counties Gas Company conceived the idea of drying these peppers by using natural gas. The plan was laid before the people engaged in the chili pepper business. No manufacturer even made the type of appliance that would be required. Our engineers had to invent, build, install and service the equipment that would do the work and secure this outlet for gas. The problem was successfully solved by the gas company engineers, and a beneficial result obtained. Similar pioneering has been carried on with respect to beet pulp drying, treatment of walnuts, and scores of other agricultural activities. It was work that could never have been accomplished except by the gas companies. The present Bill, if enacted, would put an end to this class of constructive work.

The proponents of the present Bill claim that the utilities should do the work of advertising, soliciting and stimulation of consumer demand, and then leave it to the local dealer to sell the appliance. Our experience over many years proves that the problem of making the ultimate sale cannot be left alone in the hands of the local dealer.

A year or two ago the Los Angeles Gas and Electric Corporation placed the City of Los Angeles on a straight natural gas basis. Its employees made a house to house canvas to make the necessary appliance adjustments. A list was made of homes that needed new gas ranges, and were live prospects for new stoves. This list when completed was over 10,000. Inasmuch as this company does not merchandise, its New Business Manager took this list of 10,000 live prospects to the largest furniture dealer in the city and said, in effect: "Here is a list of 10,000 live prospects, all of whom need new gas ranges. Go to it—and sell them."

The reply was that this furniture company did not go out after business in that way—they expected the public to come down to their store and buy. The list is today untouched, gathering dust in the archives of the gas company. The local dealer, carrying as he does, hundreds of lines of merchandise, simply can't be bothered with running down prospects for gas stoves. Only the utility, under the necessity of building up the volume of its sale, would go out and close the sales.

Deprive the utilities of California of the right to merchandise gas and electric appliances, and the development of our utilities, so necessary to the growth and development of our state, will be retarded to the detriment of the public at large.



SUPER-GAS, Incorporated

A somewhat imaginative report of a self-appointed manager to his unsuspecting stockholders on operations of the Year 1940

R. S. McBRIDE
Consulting Editor, American Gas Journal

In Explanation

Projecting the trends in the gas industry of today forward a decade has resulted in the formulation of a report on the imaginary operations of Super-Gas, Incorporated. That company is pictured as doing the gas business of the United States on such a scale as it may be presumed will be necessary in the calendar year 1940. In this Jules Verne type of interpretation a sincere effort has been made not to make extravagant exaggerations of either engineering or economic relations that may prevail at the end of the current decade. It is, of course, not assumed that all of the United States will have reached the status here pictured, but it is believed that a significant part of the gas industry may well have attained even the more picturesque and improbable of the operating standards and efficiencies here suggested. That the implied changes of financial structure will so soon develop is still less certain — The Author.

April 29, 1941

To the Stockholders and Patrons of SUPER-GAS, Incorporated:

During 1940 the operations of your Company were carried out on the basis of the completed Modernization Program, the result of ten year's rebuilding and reorganization of our corporate enterprise. As a consequence, in reporting to you it is appropriate that more than usual detail be presented as to the technical basis and the economic results of a decade of progress. These results, it is evident from the accompanying financial statement, have more than justified the most optimistic expectations of the management, and we believe represent an important milestone of progress in our industry.

YOUR COMPANY produced and marketed during the calendar year 1940 gas equivalent to 23 per cent of the energy supply of the area served. This output was equivalent to 20 per cent of the fuel and power requirement of the total population of the United States. Expressed as heat units, this gas represents 6,250 trillion B.t.u.

The Company output was made up with gas from a variety of sources, in the main including:

Natural gas	40 per cent
Coke-oven gas	20
Petroleum-refinery gas	18
Water gas	13
Butane and other liquiefied hydrocarbons	9

The composition, heating value, and specific gravity of our send-out varied considerably in different divisions of the Company; on the average the send-out consisted of 53 per cent saturated hydrocarbons, 24 per cent unsaturated hydrocarbons, and 23 per cent of carbon monoxide and hydrogen. The average mixture approximated in heating value 900 B.t.u. per cubic foot and in specific gravity 0.85.

The completion of the last of our major manufacturing works was accomplished during the year. There are now in the system of the Company 216 primary generating stations and approximately as many more secondary or stand-by producing works. In addition there are 730 receiving stations where the Company accepts gas from natural-gas, refinery, coke-oven, or other producing units not operated directly by the corporation. The entire generating and receiving system is under the direct control of the Vice President in Charge of Works. One of his ranking subordinates is the Manager of Supply, who is responsible for the dispatching of gas from works and receiving stations in accordance with pre-determined schedules of hour-to-hour requirements received from the division of the Company which functions under the Vice President in Charge of Distribution.

WITH THE COMPLETION of our last major manufacturing works the Company has been able to place in effect during the past year on the final units of its system the requirement that the gas sent out shall meet at all times each of the following requirements.

(a) Content of oxygen and carbon dioxide combined, not over 0.3 per cent.

(b) Total sulphur in all forms not exceeding 10 grains per 100 cubic feet.

(c) Total content of inerts normally not greater than 6 per cent, never greater than 8 per cent.

(d) Content of water vapor sufficiently low to render the water dew point at least 10 degrees below the lowest temperature to which it is anticipated the gas will be exposed at any point in transmission or distribution, in all cases taking account of the pressure under which the gas will be handled at these temperatures.

The attainment of these high purity standards has been made possible only by the investment of substantial new capital and the authorization of significantly greater expense for manufacture than would have been necessary

An address before Pennsylvania Gas Association convention, Wernersville, Pa., April 29, 1931

had lower standards been fixed. It is, however, the judgment of the management of the Corporation that the standards so fixed are more than justifying themselves in the superior service rendered to certain types of industrial customers whose business cannot be held unless definite assurance can be given under an enforceable contract for continued gas supply of extremely good performance in the customer's plant.

SINCE all manufacturing works are now operating on a modernized basis it is possible to appraise the consequent operating efficiencies of the system with great accuracy. Production at all primary and a large percentage of stand-by works is so fully mechanized that the labor requirement is lower than ever before in the history of the Company. The requirement in man-hours per million B.t.u. of gas produced in the combined coke-oven and water-gas divisions, which make up the major manufacturing activities, is now almost precisely 25 per cent of that which prevailed at the beginning of our modernization program. The mechanization which makes this achievement possible represents a substantially greater capital expenditure than prevailed in our best plants at the outset, but the increase in capital charges per million B.t.u. has been much more than justified even there by the labor saving accomplished. The closing of the less efficient plants has also been of great advantage. The wage rate for the highly skilled operatives engaged in the newer type of plant is, of course, higher than that which prevailed ten years ago. However, the labor cost per million B.t.u. is only 40 per cent of that ten years ago, and the combination of labor and capital cost is barely 60 per cent of the average for corresponding items at the beginning of modernization. As a consequence the cost to our customers for the production of the gas was less in 1940 than in any preceding calendar year.

INTERCONNECTION of plants has been an essential part of the coordinated system which is now operating. The combination of storage capacity and of transmission lines as now maintained by the system virtually precludes interruption of service in any community unless there should be a highly improbable coincidence of calamities on at least two sources of supply. The major communities of the country and the smaller towns and cities of ten thousand or more population are in general capable of maintaining uninterrupted service, even assuming that there may be a breakdown of two or more sources of supply or transmission lines, in all but a few more remote and inaccessible cities.

The use of intermediate and high pressures, that is from 800 to 1200 pounds per square inch, on our transmission system has proven an economic success for all alloy-steel transmission lines. By this system, combining welded joints with proper coupling systems, these lines are now on the average handling gas for approximately two cents per hundred miles per million B.t.u. transmitted, including operating expense and all applicable direct-capital charge. This low average cost permits economic movement of gas for distances up to 1200 miles in rare instances. The average distance of movement is, however, less than 75 miles, because great care has been taken to place our major generating and receiving stations at points near the greatest centers of consumption. Were it not for the economic necessity of moving nearly 20 per cent of our send-out for a distance between 300 and 1200 miles from points of production in Texas and Louisiana to the rest of the Mississippi Valley, the average distance traveled by gas would be under 35 miles.

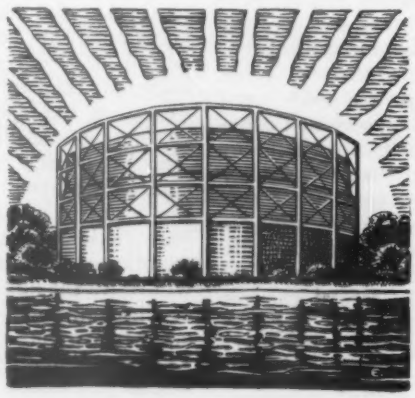
THE LAST three long-distance transmission lines constructed by your Company have been contracted for on the guaranteed-life basis. Successful bidders for these three lines, aggregating $36,000,000 in cost, have guaranteed under surety bond a 20-year life for these lines without perforation as a consequence of external corrosion. These contracts were during the past year eagerly sought under competitive bids by at least three responsible construction companies who were sufficiently versed in the protection of pipe lines against corrosion to warrant consideration as capable bidders for such large-scale work. These companies guarantee to service and maintain these lines against perforation occasioned by external corrosion during the contract period of 20 years without cost to your Company. They therefore take full responsibility not only for the system of coating the pipes used, but also for the extent to which coating was applied and the workmanship on the job. The experience of your Company with this system of contracting over the past five or six years indicates that the results more than justify the slightly greater initial cost of the line unless there be grave uncertainty as to whether obsolescence or changing needs of the Company will retire the line in a period less than 20 years. In view of this limitation on the system of contracting for guaranteed life, your Company has not applied that scheme to field collecting lines or portions of the transmission system for which ten-year or shorter life might perhaps suffice.

THE GAS STORAGE system of your Company forms one of the major reserves against interruption of service. At the present time it is made up in approximately equal parts of low or intermediate-pressure storage units in or near cities, high-pressure storage units working up to 2000 pounds per square inch, and underground repressured-gas-well storage. The system of repressuring of gas wells near centers of consumption has resulted in a substantial increase in the storage capacity of the system, especially storage for seasonal peak loads, at a cost far below that which would have been required for any mechanical above-ground units of like gas-holding capacity. Reserves of this character serve not only for peak-load season storage. They also serve as receiving units into which transmission lines may pump during low-consumption periods over week ends or during the hours of the night when the gas send-out is at a minimum. The use of this type of storage has, therefore, lent itself particularly well to the increasing of the capacity-load factor at which some of our most expensive transmission lines can be used. As a consequence, the capital cost which must be borne by the gas transmitted has been much less per million B.t.u.

BYPRODUCT ACTIVITIES in the coke-oven division of our manufacturing department have been much reduced during the past few years. During the last year was consummated the last necessary contract for the disposal of all light oil and the tar made both in the coke-oven and the water-gas divisions. These liquid-fuel products are now sold by your Company under very favorable conditions to three major petroleum refineries. In each case the refining and the marketing of products from light oil and tar is carried out by these petroleum refineries in modern, continuous, high-pressure stills at much lower cost than would be possible in smaller plants of your own Company. The products of tar and light-oil refining are either used by the petroleum-company purchasers or are sold by them through their own

affiliated chemical marketing organizations. As a consequence, during the past year less than 7 per cent of the entire production of the United States was burned as fuel. Over 93 per cent was refined for the making of either primary or secondary tar products, including those coal-tar intermediates that still form an important raw material for chemical industry.

The entire ammonia output of our coke-oven division is transferred to our affiliate, The United Ammonia Company. The operations of that concern are carried out jointly with the largest chemical-engineering enterprise dealing with ammonia and ammoniated fertilizer products. Your Company shares in the net profits of that enterprise and it is estimated that the returns to the stockholders are thereby increased significantly. The same affiliated company takes all the byproduct sulphur which is produced for use in its chemical activities.



The marketing of coke has continued during the past year on a moderately profitable basis in affiliation with the National Fuel Company, in which this Corporation is an important but minority stockholder. All of the coke is transferred from your Company's control to the merchandising system of the National Fuel Company at the point of origin. Marketing policies, are, however, subject to review, and veto if necessary, by your own Company management. This insures that the marketing of coke as a co-product of gas will not be conducted on a basis unreasonably competitive with our major product.

RESEARCH activities of the Corporation have been continued during the past year on an enlarged basis. Our production department was allotted $5,000,000 from the research budget, the distribution department a like sum, and the utilization department $15,000,000. The benefits of expenditure in all three departments have more than justified these allotments. Research expenditure has, indeed, continued to be a highly profitable investment rather than anything analogous to real expense. Your management has authorized a continuation of these research activities during the coming year. Two results of the past year's research deserve special notice.

The utilization-department studies have completed their demonstration of the proper adjustments in pressure, specific gravity, chemical composition, and heating value in order that the customer's appliances may function uniformly at all times. In those areas where full application of this system of Service Control has been applied, the number of customers' requests for appliance adjustment has been reduced to an average of one per 47 customers per year.

The operating efficiency of appliances has also been materially improved by this new Service Control system because it permits appliance adjustment with high precision since an adjustment made at any hour of the working day corresponds to the condition prevailing during all times of use of the equipment. Furthermore, uniformity in supply conditions makes it safe to adjust appliances close up to their maximum efficiency, a condition which did not prevail under former methods of supply.

The second note-worthy result of research completed during the past year has been the perfection of a new type of all-metal meter. On an experimental basis this device has been utilized in extended service tests over a period of seven years. Many of the meters in trial installations for that length of time were removed by the laboratories last year for reinspection. On test of these the average deviation from correctness was less than one-half of one per cent. No meter showed an error greater than three per cent, and only seven out of the 500 meters had as much as two per cent deviation from correctness. In the final report on the development of this meter, the laboratory recommends that our system be converted as rapidly as possible to the new type on the assumption of a routine removal from service at intervals not less than twelve years. Since none of the meters have been in service longer than seven years, and none of them in service that long showed any depreciation in performance or accuracy, it is impossible to know how long meters of the new type may be used.

This device is a positive-displacement ball-bearing meter made wholly of alloy parts, completely resistant to gas corrosion and temperature change and the other ordinary hazards of exposure on the customers' premises. It is estimated that with complete equipment of the system the unaccounted-for gas should not exceed one per cent. The losses in distribution are at present demonstrably less than one per cent. Hence, it is believed that when complete equipment with the new meter is accomplished the total unaccounted-for can be readily maintained at about 1½ per cent for the entire system of the Company.

SALES OF GAS per capita were last year a trifle over three times the sales ten years before. Industrial sales accounted for 45 per cent of our total send-out. House heating, house cooling, and analagous services in commercial establishments required about 27 per cent. Industrial cooking and institutional service accounted for 10 per cent. And miscellaneous household service, such as water heating, cooking, incineration, and other uses, took the remaining 18 per cent of our send-out.

The extension of service in rural areas continued at an increasing rate during the past year. Approximately 700,000 new farm customers were added, either through our division of bottled-gas service, or by connection with high-pressure service lines. Through enlargement of the bottled-gas division activities the rates for this service have been materially reduced, so that the cost in most areas is only approximately 30 per cent above that for corresponding service from transmission lines. The utilization department of the Company estimates that nearly 50 per cent of the rural population is now served by your Company. With extension of service continuing at anticipated rates, all areas which are practicable of access at gas prices reasonable from the standpoint of the customer will be reached within the next five years.

STANDARD RATE SCHEDULES of the Corporation were last year adopted by three more state authorities, making the rate system used by the country entirely uniform. This rate schedule varies the charges for gas to any individual customer according to his capacity-load factor and according to the quantity of gas used. For a typical division of the Company

where the nominal, or base, rate is $1.50 per million B.t.u., the rates scale downward according to quantity consumed on low-capacity-load factors to 75 cents per million B.t.u.; but the decreases for increasing capacity-load factor are much greater. Hence, the customer, even one of moderate size, who affords a favorable regularity in consumption may secure his supply as low as 60 cents per million B.t.u., and the large customer of similar load factor often attains a rate of 40 cents.

The greatest benefit in stabilizing gas-supply conditions has come from the adoption of rates for seasonal supply, daily off-peak (night-hour) consumption, and for "dump" gas. In a few instances the rates for "dump" are as low as 20 cents per million B.t.u. Such rates are peculiarly attractive to industrial establishments having small week-end power requirements. Such customers take week-end gas supply under conditions which permit maintenance of factory-heat or factory-steam service with one boiler-plant operative. The change-over from powdered coal, used five and a half days a week, to gas used over the week end, is frequently possible in 30 minutes with the work of two mechanics. This week-end service has served to stabilize send-out requirements so that at the present time there is substantially no day-to-day variation in total requirement. Certain seasonal customers have been provided at rates of approximately 35 cents per million B.t.u., so that the seasonal load curve of the Company varies less than 10 per cent from the average, figured on three-day send-outs.

OWNERSHIP of your Company has been even more widely extended by the financing operations of the past year. Retirement of the last of the older security issues has been substantially completed. The financial structure of the Company now consists essentially of 5-per cent bonds for 50 per cent of the total capital, 6½-per cent cumulative preferred stock for 20 per cent of the value, and common stock covering 30 per cent of the total investment. Approximately 50 per cent of the bonds are owned by customers of the Corporation who have purchased them directly from the Corporation treasury. The balance has been sold with no charge for commission to insurance companies, investment trusts, and other institutional investors. The cost of bond financing to your Company has been approximately one-third that which formerly prevailed when issues were sold exclusively through investment-bond or brokerage houses.

All of the preferred stock of the Corporation, except a nominal amount in the Company treasury, has been sold to customers. Its popularity is evidenced by the fact that it is quoted currently on the market at a price making the yield to purchasers a trifle less than 6 per cent.

The common stock of the Company is in three classes, each sharing in all rights, privileges, and responsibilities equally under all ordinary circumstances. However, in case of failure to earn a sum warranting payment of regular dividends at the rate of $8 per share on a par value of $100, the publicly held shares of Class A are preferred as to dividends. Class B shares are owned exclusively by the staff and employees of the Corporation whose salaries are not greater than $10,000 per year. Shares of this Class B are preferred as to dividends over Class C shares. Class C shares are owned by the managers of the Corporation in proportion to their rights of participation. Approximately 12,000 executives of the Company, including general, regional, department, and division officers, are included. No shares of the common stock of the Company of Class B or C may be offered to the public. Class A shares in the hands of our customers are, however, quoted regularly and dealt in actively on the more important exchanges.

Voting rights of all classes of shares are equal at all times except if for three successive quarterly periods earnings have not warranted payment of regular dividends on Class A shares. In that event, Class A shares have the exclusive voting rights and thus may control the naming of officials and insure an appropriate change in management to restore your Company to a profit-making operating basis.

NET PROFIT of your Company last year, as shown by the balance sheet separately reported, amounted to $14.66 per common share of stock outstanding after payment of all expenses, obsolescence and depreciation reserves, bond interest, and preferred-stock dividend. In accordance with the standard rate schedule of the Corporation there was set aside from these net earnings the equivalent of $1.55 per share for reduction in the rate for gas during the coming year. This allotment corresponds to one-third of the excess in the earnings above $10 per share. Ten per cent of the remaining earnings equal to $1.31 per common share, were then set aside for the continuous employment reserve and employees' benefit fund. This sum is now sufficient so that at no time need any employee of your Company fear the contingencies of unemployment, illness, or accident. This certainty of earning power and protection against misfortune is believed by your Board of Directors greatly to strengthen the cooperative spirit which has prevailed throughout the staff of the Company and to enable the management to select a much more dependable and desirable type of employee for every grade of work.

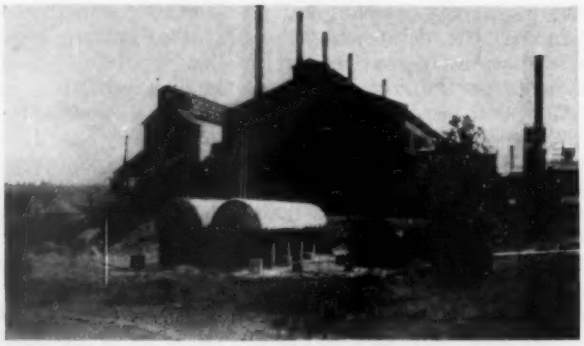
From the balance of $11.80 per share there was declared by your Board of Directors the regular common-stock dividend of $8 per share and an extra dividend of $2 per share. The balance of net earnings, amounting to $1.80 per share was transferred to the earned surplus account for the stabilization of dividend payments and rate schedules of the future. The charter of the Company provides that when this earned reserve equals 30 per cent of the par value of the common stock outstanding further allotments to this fund will not be created. Excesses of this sort will then be equally divisible between the common-stockholders, the preferred-stockholders, and the customers' rate-reduction fund. It is estimated that within the next three years the accumulated surplus will reach this total. Then the preferred stock will be advanced to a $7 or $7.50 basis, and the common stock will pay $11 per share.

YOUR MANAGEMENT takes pride in reporting that during the past year seven out of seventeen major geographic divisions of the Corporation operated without a lost-time accident to any employee. Four other divisions suffered three or fewer lost-time accidents, and in only one geographic division were there more than twelve lost-time accidents during the year. The public liability insurance rates charged to your Company are now the lowest granted to any type of commercial or manufacturing enterprise by any responsible insurance company. Settlement of all claims to the public and to staff employees during the year occasioned a cost to the Company equivalent to 0.003 cents per million B.t.u., an almost negligible item in the cost of doing business.

The Use Of Butane In Meeting Peak Load Conditions

E. W. EVANS

Gas Manufacturing Division,
Philfuels Company, Detroit, Michigan.



Butane Storage for Natural Gas Standby at Industrial Plant. Equivalent to 4½ million feet of Natural Gas

THE present increasing consumption of gas, due to the growing use for industrial and house heat-purposes, makes the subject of meeting peak loads one of the serious problems confronting the gas industry.

The total volume of peak load gas is in most instances only a small percentage of the annual sendout. Consequently, the cost of providing this additional volume is excessive, due to the fixed charges on the high investment required for generating equipment or transmission lines.

The increase in natural gas transmission lines has made this fuel available to a large territory, and the increase in natural gas consumption has been one of the outstanding developments of the past few years. The substitution of natural gas for manufactured gas does not eliminate the peak load problem but, in some respects, makes it even more serious. The majority of engineers are agreed that the minimum load factor for the economic operation of natural gas transmission lines is 70%. Moreover, there is always present the danger of interruption in gas service, due to mechanical injuries to the pipe line. Therefore, it is quite apparent that provisions must be made for meeting peak loads and in some cases to provide standby reserves.

Importance of Mixed Gas Study

An increasing tendency towards the distribution of mixed gases, such as natural gas and water gas, or natural gas and coal gas, is evident. The study of mixed gases is of increasing importance not only from the above mentioned point of view, but in connection with the peak load problems.

Butane, due to its low cost and availability, and to the low cost of storage, handling and utilization equipment, provides a valuable means of meeting seasonal, as well as periodic peaks. Butane, with its high thermal content, lends itself readily to mixing with other gases to increase their thermal value. The similarity of its combustion characteristics to natural gas permits its substitution for natural gas within certain thermal value ranges.

It is interesting to note that one 10′ x 40′ storage tank has a capacity of 212 therms of natural gas at 75 lbs. pressure, but would hold over 24,000 therms of liquid butane or 115 times as many B.T.U.

As the success of any method of gas distribution is directly dependent upon maintaining satisfactory appliance operation, it is imperative that a close examination be made of peak load mixtures in order to determine the volumetric increase possible without the necessity for appliance readjustment. Using the accepted mathematical formula for gas flows, and assuming limits of variations based on experimental data and practice, it is possible to predict combustion properties of mixtures in domestic and industrial appliances.

The properties of liquefied petroleum gases have been given considerable publicity in the trade journals and are fairly well known to the gas industry. The following properties of butane are taken from reports of Philfuels Company and the Research Department of Phillips Petroleum Company.

Properties of Butane

Maximum Vapor Pressure lbs./sq. in. gauge at 70°F.	33
Maximum Vapor Pressure lbs./sq. in. gauge at 100°F.	65
Maximum Vapor Pressure lbs./sq. in. gauge at 105°F.	71
Temperature at which gauge pressure is 0 lbs./sq. in.	15°F.
Specific Gravity of liquid (water = 1)	0.576
Weight per gallon of liquid, lbs.	4.8
Specific Gravity of gas (air = 1)	1.95
Cubic feet of gas per lb. liquid	6.7
Cubic feet of gas per gallon liquid	32
Cubic feet of gas per cu. ft. liquid	239
Maximum rate of flame propagation	
Cm. per sec. in 2.5 Cm. Dia. tube	82.5
Heating value	
B.T.U. per cu. ft. of gas	3,200
B.T.U. per lb. of gas	21,300
B.T.U. per gallon of gas	102,400

Actual experience with the use of butane for peak load conditions has shown its usefulness for this purpose. The Louisville Gas and Electric Company can produce a carbureted water gas of about 600 B.T.U. with an increase in plant capacity of about 30%, by using the Willien-Stein low gravity process with a 15 second blow run, and a final enrichment with butane. This gas is then mixed with the available natural gas to such an extent that not less than a 875 B.T.U. mixture results. Satisfactory service without appliance readjustment is thus obtained during peak load conditions. A complete report of the methods used and results secured is given in the A. G. A. Proceedings for 1929, pages 834 to 854.

An experimental test was conducted at a middle western coal gas plant in May, 1929, on the enrichment of lower heating value coal gas made by increased steaming of vertical retors. It was found possible to increase the plant capacity about 11% by increasing the steaming pressure from 30 lbs. to 55 lbs. A reduction in thermal value from 560 B.T.U. to 530 B.T.U. was noted. The enrichment to 560 B.T.U. with butane resulted in a gas of specific gravity of 0.448 as compared to the

normal 0.432 specific gravity. Appliance operation on the higher gravity mixture was quite satisfactory.

The use of butane as standby or reserve fuel for industries using natural gas has demonstrated another usefulness in augmenting and supplementing the gas supply. The accompanying photograph shows the butane storage of one of the industrial plants served with natural gas using butane as reserve fuel. Dilution with air reduces the thermal content to the desired utilization value, and the similarity of combustion characteristics of butane and natural gas permits the use of the same burner equipment for both fuels.

Before discussing the various mixtures of butane and other gases for peak load conditions, a breif consideration should be given to the combustion problems to be encountered in mixing gases with different physical and chemical properties. From the consumers viewpoint the following points must be kept in mind:

(1) There must be no noticeable decrease in heating time.
(2) There must be no tendency for the flames to lift from the burner.
(3) Combustion must not be noisy with tendency to flash back.
(4) There must be no formation of CO with the accompanying aldehyde odor and blacking of of utensils.

All of the above cautions must be observed in the manipulation of the four inherent factors having a direct bearing on the satisfactory performance of gas appliances. These factors are,

1. Specific gravity of the gas.
2. Heating value of the gas.
3. Chemical composition of the gas, and
4. Gas pressure at the appliance.

In the following discussion the fourth factor is assumed to be constant as it is beyond the immediate control of the operator. Likewise such appliance characteristics as orifice and port sizes are assumed to be constant, as appliance readjustments during peak load conditions are impractical.

Effect of Specific Gravity Changes

A change in specific gravity results in a change in volume delivered by a burner orifice according to the equation.

$$Q = AK\sqrt{\frac{h}{d}} \text{ where}$$

Q = volume delivered per unit of time
A = orifice area
K = orifice constant
h = orifice pressure
d = specific gravity

As A, K, and h are considered constant, the relative volumes of two gases with specific gravities d, and d_2 may be expressed

$$\frac{Q_2}{Q_1} = \frac{AK\sqrt{\frac{h}{d_1}}}{AK\sqrt{\frac{h}{d_2}}} = \frac{\sqrt{\frac{1}{d_1}}}{\sqrt{\frac{1}{d_2}}} = \frac{\sqrt{d_2}}{\sqrt{d_1}}$$

and

$$Q_2 = Q_1\sqrt{\frac{d_1}{d_2}}$$

The specific gravity also plays an important part in determining the air gas ratio of the burner mixture. At constant pressures and orifice conditions, a change in specific gravity causes compensating changes in the velocity of the gas stream, and weight of gas delivered per unit of time, such that the product of the two (momentum) is a constant. The entrained (primary) air is a direct function of the momentum of the gas stream, and is, therefore, constant for given orifice pressure and conditions, regardless of the specific gravity of the gas. The gas volume delivered decreases with increased specific gravtiy as shown by the orifice equation, and the mixing of a constant volume of entrained air with a decreasing volume of gas results in an increasing air-gas ratio within the burner, and the mixture is characterized as lean. The opposite tendency (towards rich mixtures) is noted with decreased specific gravity.

Effects of Heating Value Changes

Mixtures of various gases and air in the proper proportion for complete combustion have approximately the same thermal content, regardless of the thermal value of the gas itself. Certain low heating value gases such as producer gas and blast furnace gases are exceptions to this rule. The following table prepared from data presented in "Fuels and Their Combustion" by Haslam and Russell illustrates this relationship.

Gas	B.T.U. per Cu. Ft.	Cu. Ft. Air Required for Complete Combustion of One Cu. Ft. of Gas	B.T.U. Content of One Cu. Ft. of Air-Gas Mixture
Coal Gas	634	5.50	97.5
Coke Oven Gas	536	4.65	94.8
Coke Oven Gas	600	5.28	95.5
Blue Water Gas.....	310	2.28	94.5
Carbureted Water Gas	578	4.85	98.8
Oil Gas	516	4.25	98.2
Natural Gas	1047	10.04	95.0
Butane	3200	30.8	100.0

It can be stated that a fairly constant volume of air (primary plus secondary) is required for the complete combustion of any mixture of gases distributed for commercial uses giving a constant appliance thermal input.

An increase in heating value, specific gravity and burner pressure being maintained constant, results in the same volumetric delivery of gas by an orifice, and the same air-gas ratio within the burner, but an increased burner thermal input accompanied by an increased thermal output per burner port. This results in an increased volume of air required for complete combustion, and as the inspirated air remains constant more secondary air is required. Beyond a certain point yellow tips, soft flames, and CO formation results, as insufficient secondary air is available for complete combustion.

Effects of Variations in the Chemical Composition of the Gases

The most important variable due to change in chemical composition affecting appliance operation is the rate of flame propagation, or ignition velocity. Experimental data shows that the average mixture velocity through burner ports may exceed by a considerable margin the rate of flame propagation of a gas as determined in a 1" diameter tube. Table No. 1 illustrates this tendency.

Table No. 1

Drill Size of Port	Area in Sq. In.	Max. Velocity Through Port Without Lifting of Flame. 550 B.T.U. Butane-Air Gas
No. 44	0.0058	60 inches per second
No. 36	0.0089	53 inches per second
No. 32	0.0106	51 inches per second

The maximum rate of flame propagation of butane-air mixture in a 1" diameter tube is 33 inches per second. The increased port wall friction of the smaller ports reduces the velocity of the outer ring of the air-gas mixture to less than the maximum rate of flame propagation, whereas the average mixture velocity through the port may be considerably greater. It is necessary to maintain the rate of flame propagation high enough to avoid lifting of flames from the burner ports, or to enlarge the ports sufficient to reduce the port velocity of the air-gas mixture. The second method is used for burners with the butane-air system for gas manufacture, and the first named method is necessary under peak load conditions. No trouble should be experienced from variations in chemical composition as long as it is possible to secure the required burner thermal input without lifting of flames.

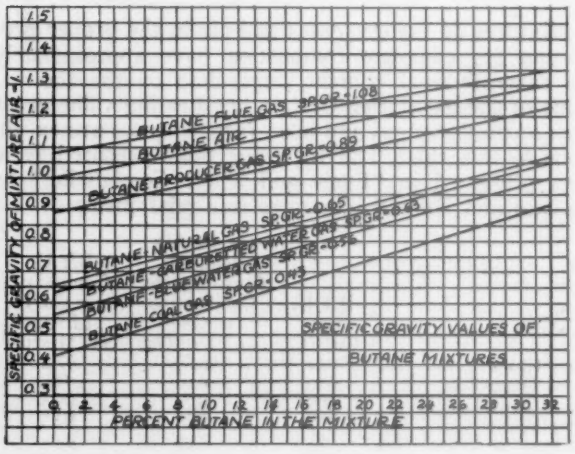


Figure 1

It is possible to manipulate the heating value and specific gravity of the distributed gas so as to compensate for their individual effects. To maintain customer satisfaction, it is necessary to hold the appliance thermal input within certain limits. With standard burners, having ample distance between burner ports and grate to avoid flame impingement, the heating up time is a direct function of the thermal input. The conditions that must be met for peak load periods are two:

(1). The appliance thermal input must not be decreased to such an extent that the heating up time is noticeably decreased.

(2). The chemical composition must not be varied to such an extent that flames blow from the burner ports under the required thermal input conditions.

It will be noted in the above that lowering of the thermal input and decreasing of the rate of flame propagation are the limiting factors. The use of butane mixtures always results in the latter conditions, and usually results in the former as the decreased gas flow due to increased specific gravity results in a decreased thermal input unless the heating value is considerably increased. In the following discussion the higher limits will sometimes be given, although economic considerations are against the distribution of a gas with high enough thermal content to more than balance the effect of increased specific gravity.

From experimental data on allowable heating value variation with constant specific gravity, it may be stated that a plus or minus 10% variation in thermal input from the normal input is allowable for heating operations, except those involving furnace atmospheres in industrial processes, in which a maximum variation in thermal input of about 5% is permissible. However, the industrial gas burning equipment is capable of individual adjustment, so that a 10% variation may be considered allowable during peak load periods.

The following gases may be considered as available for mixing with butane:

Table No. 2

Gas	Heating Value B.T.U./Cu. Ft.	Specific Gravity
Coal Gas	570	0.43
Blue Water Gas	300	0.56
Carbureted Water Gas	530	0.63
Natural Gas	1100	0.65
Producer Gas	150	0.89
Air	0	1.00
Flue Gas	0	1.08

Figure No. 1 illustrates the specific gravity results obtained by mixing butane with various gases. It will be noted in all cases that the addition of butane results in increased specific gravity.

Figure No. 2 correlates thermal values of the mixture with percentages of butane present in the various mixtures. The rapid increase in thermal value with increased butane content is quite apparent.

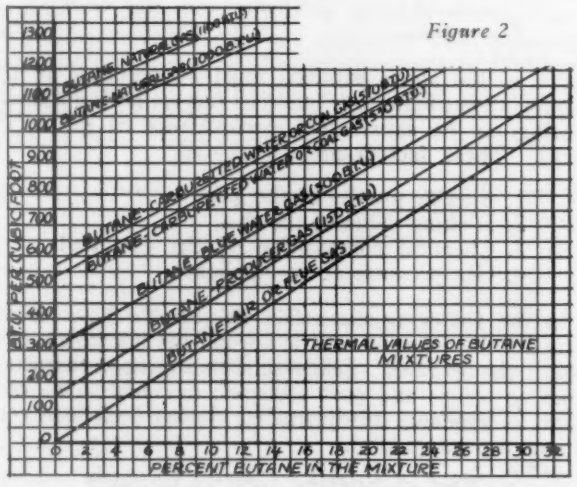

B.T.U. PER CUBIC FOOT
BUTANE-NATURAL GAS (1100 B.T.U.)
BUTANE-CARBURETTED WATER GAS (530 B.T.U.)
BUTANE-BLUE WATER GAS (300 B.T.U.)
BUTANE-PRODUCER GAS (150 B.T.U.)
BUTANE-AIR OR FLUE GAS
THERMAL VALUES OF BUTANE MIXTURES
PERCENT BUTANE IN THE MIXTURE

Figure 2

Figure No. 3 combines the specific gravity and thermal value increase effects on thermal input into appliances. Normal input is based upon an orifice size capable of passing 10 cu. ft. of 570 B.T.U. coal gas of 0.43 specific gravity per hour. The thermal input is the product of the thermal value of the mixture and the quantity passed per hour as determined by the formula,

$$Q_2 = Q_1 \sqrt{\frac{d_1}{d_2}}$$ in which

Q_2 = the volume of butane mixture delivered per hour
Q_1 = the volume of base gas delivered per hour (570 B.T.U. coal gas)
d_1 = the specific gravity of the base gas (0.43)
d_2 = the specific gravity of the butane mixture

Figure No. 4 presents the thermal inputs of various butane mixtures referred to a 1100 B.T.U. natural gas of 0.65 specific gravity.

The use of Figures No. 3 and No. 4 consists of placing limits on the percentage of butane that may be mixed with the gases in question without exceeding the 10% thermal input variation. The change in rate of flame propagation in some cases may be the determining factor rather than the thermal input variation. The substitu-

tion of butane-air for coal gas, for example, would not be possible without appliance readjustment, although equivalent thermal inputs could be easily secured.

Coal Gas and Butane Mixtures

Butane may be used for meeting peak load conditions in coal gas plants by the addition of butane-air or butane-flue gases to the coal gas. The use of butane-air in some cases may be inadvisable, as former water gas usage may have formed deposits on meters and governor diaphragms, which harden in the presence of oxygen. The use of flue gases presents certain difficulties among which are decreasing of rate of flame propagation as compared to butane-air systems, due to the presence of inerts, and the need for purifying of flue gases. The following table represents the possible butane-air combinations with coal gas within the 10% downward variation in thermal input.

Table No. 3

Mixtures of Coal Gas and Butane-Air

Percent Butane in Butane-Air Mixture	B.T.U. of Butane-Air Mixture	Max. Percent of Butane-Air in Mixture	B.T.U. of Mixture	Percent Volumetric Increase Possible
17.8	570	13.0	570	14.9
18.1	580	13.8	572	16.0
18.75	600	14.5	575	17.0
21.0	673	16.9	587	20.3

The use of the above table is in determining the maximum amount of butane-air that may be added to coal gas (570 B.T.U.) without exceeding a 10% thermal input. For example 13% of 570 B.T.U. butane-air may be mixed with 87% coal gas, giving a 570 B.T.U. distributed mixture, with an appliance thermal input within 10% of normal. The volumetric increase is based on the coal gas in the mixture

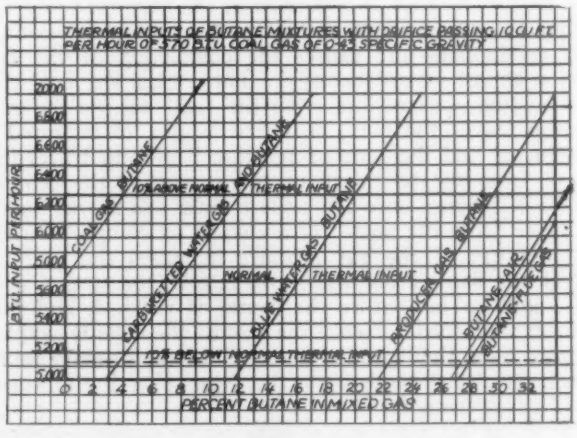

THERMAL INPUTS OF BUTANE MIXTURES WITH ORIFICE PASSING 10 CU.FT. PER HOUR OF 570 B.T.U. COAL GAS OF 0.43 SPECIFIC GRAVITY
B.T.U. INPUT PER HOUR
10% ABOVE NORMAL THERMAL INPUT
NORMAL THERMAL INPUT
10% BELOW NORMAL THERMAL INPUT
PERCENT BUTANE IN MIXED GAS

Figure 3

Increased steaming of vertical retorts offers a method of utilizing butane for securing volumetric increases. A lower thermal value gas is secured which, on mixing with butane, can be distributed at the desired B.T.U. value.

Natural Gas and Butane

The mixtures of natural gas and butane, or the direct substitution of butane-air for natural gas in case of failure of supply offers an ideal standby or reserve system for industrial plants supplied with natural gas. Burning characteristics of the gases are identical, and thermal inputs can be closely controlled.

Figure No. 4 represents thermal input results and as shown here natural gas and 1800 B.T.U. butane-air may be mixed in any proportion without appliance difficulties.

The distribution of mixtures giving thermal inputs greater than normal is not economic, and for high thermal value gases such as natural gas an increase in thermal input above 5% might lead to insufficient secondary air conditions. The direct addition of butane to natural gas results in a rapid thermal value increase and the maximum percent of butane that could be added would give a volumetric increase of not more than 10%.

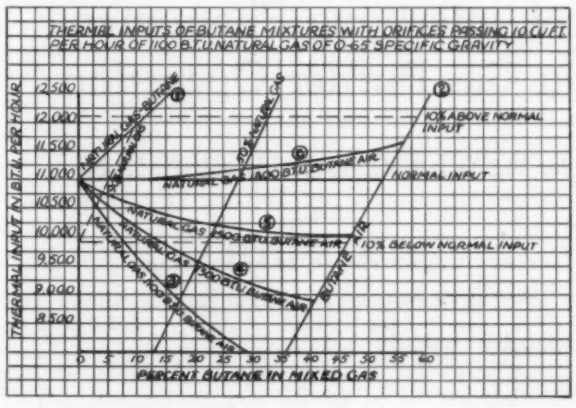

THERMAL INPUTS OF BUTANE MIXTURES WITH ORIFICES PASSING 10 CU.FT. PER HOUR OF 1100 B.T.U. NATURAL GAS OF 0.65 SPECIFIC GRAVITY
THERMAL INPUT IN B.T.U. PER HOUR
10% ABOVE NORMAL INPUT
NORMAL INPUT
10% BELOW NORMAL INPUT
PERCENT BUTANE IN MIXED GAS

Figure 4

Mixing of butane-air with natural gas offers the most attractive method of securing volumetric increases. No change in thermal value of the sendout gas is experienced in mixing 1100 B.T.U. natural gas and 11000 B.T.U. butane-air, although a fairly rapid falling off in thermal input is secured, due to increased specific gravity. As taken from curve No. 3 of Figure No. 4, the 10% below normal thermal input is reached with a mixture containing 8% butane or 23.2% butane-air

$$\left((23.2 = 8 \times \frac{3200}{1100} \right),$$

making a volumetric increase of

$$\frac{23.2}{100 - 23.2} = 30.2\%$$

of the natural gas available.

Every M increase in sendout due to the addition of 1100 B.T.U. butane-air requires 344 cu. ft. or 10.72 gallons of butane.

For volumetric increases greater than 30%, a higher thermal value butane-air mixture is required. A 1300 B.T.U. butane-air mixture makes possible a volumetric increase of 55.5% of the natural gas available, and requires 12.7 gallons of butane per M increase in sendout.

Butane-air mixtures with thermal values between 1500 and 1800 B.T.U. may be substituted directly for natural gas, although best results have been secured in practice by the use of a 1700 B.T.U. mixture.

Mixtures of butane, natural gas, coal gas and water gas offer many possibilities, but are capable of too many component variations to attempt to cover them in this discussion.

Conclusion

Many butane combinations are possible for peak load conditions including mixing with water gas, with blue water gas and natural gas, with cracked natural gas, and mixing of cracked butane with any of the commercial gases.

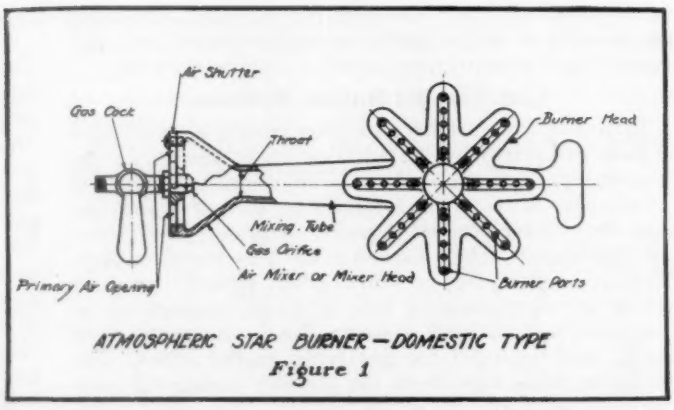
(Continued on page 78)

Gas Burner Design

1—Underlying Phenomena in Gas Burner Operation

E. R. WEAVER, J. H. EISEMAN, and F. A. SMITH

Bureau of Standards, Washington, D. C.



ATMOSPHERIC STAR BURNER—DOMESTIC TYPE
Figure 1

THE various steps in designing a gas burner can be made, systematic and comparatively simple. The principal formulas which are used should, however, be applied with caution, because of the varied character of gas-burning appliance; and a real understanding of the principles involved is an essential to attainment of correct design.

There is no burner of any given design which is best for all services. A burner to be good must be designed with reference to the appliance in which it is to be used, and no burner can be tested and judged to be superior or even satisfactory except as an integral part of the whole appliance. The Bureau of Standards has never recommended or approved a "standard" burner for general use or even for all appliances of any one type, because such a standard is not considered desirable. Representations to the effect that a particular burner is recommended by the Bureau of Standards or has been built in accordance with the Bureau's specifications are, therefor, misleading.

Figure 1 shows a sketch of a commonly used range burner, the different parts of the burner indicated according to the nomenclature commonly used. The real functioning of such a burner is simple; but as it is often misunderstood, a full presentation of underlying phenomena and their interrelation is justified.

The Flame Phenomena

As the gas leaves the orifice it possesses a considerable amount of "kinetic energy" or energy of forward movement. This energy is in part transferred to the air in the mixer head and throat, imparting a forward movement to it also. Air flows into the mixer head to replace that which has thus moved into the "burner head."

When the mixture of gas and air flowing through the ports is ignited the chemical combination of the oxygen of the primary air with the constituents of the fuel gas takes place in a thin greenish-blue conically shaped zone called the inner or primary "cone" or the "zone of primary combustion". It is often supposed that the entire space bounded by the visible "cone" is a region of vigorous chemical reaction, but such is not the case. When not obscured by fluttering or other conditions that interfere with observation, the zone of primary combustion is found to be paper-thin, and the reaction between gas and primary air is begun and substantially completed while they are flowing through the minute distance represented by the thickness of the zone. The stationary position, with reference to the burner, of the zone in the moving gas stream is the result of an equilibrium or balance between the flow of the primary mixture and the tendency of the flame front to move into the unburned mixture.

Factors Influencing Size of Cone

The position of the primary combustion zone is maintained by the conduction of heat from the gases which have already reacted into the stream of those which have not reacted, raising them to a somewhat indefinite "ignition temperature." When this temperature is reached the heat of reaction in a portion of the mixture suddenly raises the temperature of that portion, without waiting for conduction, and causes the completion of the reaction almost instantaneously. The conical shape of the combustion zone results from the fact that, as the gas stream leaves the port, heat first begins to be rapidly conducted and the zone of reaction begins to travel inward from the boundary of the stream to the center, which it reaches only after the stream has moved some distance from the port. If a change of composition or temperature of the gas mixture increases the rate at which the flame front will move into it, the stream will not move so far before the center is reached, and the cone is shortened. Hence the size of the cone is said to depend upon the "ignition velocity" of the primary mixture. It also depends upon the velocity of the mixture as it leaves the port.

If the primary air is just sufficient to supply one atom of oxygen for each atom of carbon in the hydrocarbons, the hydrocarbons are practically completely converted into hydrogen and carbon monoxide in the primary zone. If less oxygen is present it forms as much carbon monoxide as possible and the remaining hydrocarbon usually decomposes to some extent into hydrogen and carbon. The carbon appears as finely divided glowing particles which impart the luminous yellow color to the flame. Because of its great chemical stability and low carbon content, methane alone of the hydrocarbons does not usually become sufficiently heated to yield carbon and a yellow flame in this way. This decomposition of the hydrocarbon to form hydrogen and carbon is extremely slow in comparison with the primary reaction with oxygen, and therefore, continues while the gas travels a considerable distance beyond the primary zone.

A summary based on a letter prepared for answering inquiries to be issued as Letter Circular 299.

If an amount of air more than sufficient to convert the carbon of the hydrocarbons to carbon monoxide enters the primary zone, the excess reacts with a portion of the carbon monoxide and hydrogen, originally present or formed from the hydrocarbons, to produce carbon dioxide and water. The relative amounts of carbon monoxide and hydrogen burned under these conditions depend upon the original concentrations and the temperature in the manner represented by the "water-gas equilibrium", which will be familiar to students of physical chemistry.

Secondary Reactions

The remaining reactions of importance, those in which carbon monoxide, hydrogen and any residual hydrocarbon are finally oxidized by secondary air, also take place in a very thin zone which is sometimes called the "outer cone" or "mantle" of the flame. In this secondary zone, oxygen and the combustible gases are exactly equivalent and combine without leaving any surplus of either. Inside the zone there is a fairly high concentration of carbon monoxide and hydrogen, but no uncombined oxygen. At a very short distance, but outside the zone, there is much free oxygen but no combustible material, unless the temperature is too low to permit vigorous reaction, in which case, the zone of secondary combustion will be invisible or nearly so.

A steady, clearly defined secondary zone that forms a closed surface is, therefore, the visual indication that secondary air reaches the region of the flame in sufficent quantity to oxidize the combustibles completely while they are still hot enough to burn.

When inert gas, from products of combustion or otherwise, mingles with the secondary air or when the supply of air is insufficient, the zone of secondary combustion moves outward and may waver and become "ragged" in appearance. Under such conditions carbon monoxide is likely to escape, especially if the gases come into contact with a relatively cool object before reaching the secondary zone. Contrary to common supposition, the appearance of the primary cones is of no value in determining whether combustion is complete unless judged by an experienced adjuster already familiar with the requirement for primary air of the particular gas used, when burned in an appliance of the design under observation. It is the appearance of the secondary zone which is of general importance in determining whether combustion is complete.

The behavior of the carbon in a luminous flame is interesting, though not very important, because such flames are avoided in good practice. Carbon reacts at flame temperature with both water vapor and carbon dioxide, hydrogen and carbon monoxide being formed in the first case, carbon monoxide only in the second case. The carbon formed in or shortly beyond the primary zone thus tends to react with the products of combustion which diffuse inward from the secondary zone and may entirely disappear before the secondary zone is reached. The solid particles of carbon are relatively slow to react as compared with the gaseous molecules, however, and may not only fail to be completely oxidized inside the secondary zone, but may pass entirely through it and the surrounding region of high temperature, and cool too much to burn completely. In this case we have a smoky flame. Carbon once formed in the flame requires much more favorable conditions for its complete oxidation than does any of the other combustible substances, hence any appearance of a yellow color in a Bunsen flame is to be avoided.

When the composition of a gas supply is known from analysis, the amount of "air" required for complete combustion" may be easily computed by the use of simple chemical equations. The compositions of different gas supplies and even of the same gas supply at different times vary so much, and actual analyses are so infrequently published, that this method of determining the air required is seldom available to the appliance designer. It may be assumed with sufficient accuracy for most purposes connected with design that nine cubic feet of air will be required per thousand Btu liberated and that the products of combustion will have a volume of ten cubic feet (including water vapor) per thousand Btu, volumes of gas being referred to 60° F. and 30 inches of mercury. If, for example, a burner is to inject 50 per cent of the air required as primary air and the appliance is to take 100 per cent excess secondary air, it should be designed to take 4.5 cubic feet per hour of primary and 13.5 cubic feet of secondary air per 1000 Btu of its hourly "rating".

The Requirements of a Satisfactory Burner

The following major requirements must be met in order that a burner shall be satisfactory:

1. Combustion must be complete. Neither carbon nor carbon monoxide must escape from the flame.
2. The flame must not lift or be blown from the ports.
3. The flame must not "backfire" (or "flashback").
4. The heat must be applied as efficiently as is consistent with good practice in other respects.
5. The flame must travel readily from port to port when the gas is lighted.
6. The distribution of heat with respect to its application must be satisfactory. Attention to this requirement is of importance in some appliances but not in others.
7. Unusually difficult or expensive construction must not be involved unless it results in compensating advantages.

Not only must these requirements be met under a single condition of service, but large variations both in the conditions of gas supply and the service demanded must be provided for by the designer in most cases. With simple changes that can be made by the gas fitter, an appliance that is widely distributed must work at normal pressures of three inches or ten inches of water and with gases having a considerable range of composition and properties. After being set up and adjusted it must not be unusable with pressure variations as great as 1.5 times the minimum pressure. Rather wide changes in specific gravity, "ignition velocity", volume of air required for complete combustion and other properties may be combined with these changes of pressure. A factor of safety must be provided for inexact workmanship during manufacture and for a certain amount of change in use, including the effect of accumulated dirt and unfavorable conditions of "draft." A "top burner" must give good service at full rating when heating laundry water or at ten or twenty per cent of full rating when keeping food warm; and some other appliances are expected to give only less varied service.

Compromises Involved in Burner Design

These requirements are simple to meet individually; complying with them as a group is not so simple because changes that are favorable with respect to one requirement are in many cases unfavorable with respect to another. This makes it necessary to exercise good judgment in determining how far to go in sacrificing one characteristic for the sake of improving another. Some

of the more important of these necessary compromises will be indicated.

Not all of the secondary air which passes through a burner box reaches the flame at a time when reaction is possible; hence one must always have an excess of secondary air and this excess must be made large enough to insure that combustion will be complete under unfavorable conditions that arise in service or result from imperfect workmanship. On the other hand an excess of air carries away heat; therefore, in order to obtain high efficiency it should be kept at a minimum. The spacing of the burner with respect to the object heated, especially the top burner of a range, often involves the same conflict between efficiency and completeness of combustion. Since primary air always enters the flame under conditions which give it the best possible opportunity to react, an increase in the amount of primary air makes possible a more than equal reduction in secondary air and an improvement in efficiency without sacrificing completeness of combustion. But an increase in primary air renders the flame less stable and more likely to blow off or backfire. The tendency to blow off can be counteracted by making the ports larger or decreasing the velocity, through them, of the primary mixture; the tendency to backfire can be counteracted by making the ports smaller or increasing the velocity of the mixture.

Primary Air and Flame Stability

The relationship of primary air to the stability of the flame is so important that it should be fully discussed. If we start with a flame in which there is no primary air there is obviously no possibility of backfiring and the mixture must issue at a very high velocity to cause the flame to "lift" (blow from the port). The flame is also difficult to extinguish by a cross current of wind.

If the proportion of primary air in the mixture is gradually increased, the rate of gas supply at which lifting occurs will decrease at each step, and the rate of gas supply at which backfiring occurs will increase at each step. Hence, the available range of rates of heat supply will diminish until a condition is reached such that the flame will burn at only one rate of gas supply, and either lifting or backfiring will result from the slightest variation. If still more air is introduced it is impossible to light the burner at all. If a port of smaller diameter is drilled, the rate of gas supply at which a given mixture of gas and air will cause lifting is reduced somewhat, but the rate at which backfiring occurs is reduced much more. Hence a higher percentage of primary air may be employed, but the amount of heat that can be delivered by a single port is diminished. The height of the flame is also reduced and much more heat is transmitted to the burner, which is usually undesirable.

In order to increase the amount of primary air, for the purpose of increasing efficiency and insuring complete combustion, it is therefore necessary, in general, to make the ports smaller and enough more numerous to increase considerably their total area; but improvement in this direction is accompanied by increased cost and difficulties in manufacturing. To carry this development to its conclusion and introduce all the air required as primary air may require that the burner head approximate a porous plate with its so-called "surface combustion." It is difficult to inject enough primary air into such a burner at ordinary service pressures, and the heating of the burner creates an additional problem.

The result of the most satisfactory compromises between the amount of primary air entrained and the other factors mentioned depends upon the purpose for which the burner is to be used. Range burners which must give service at widely varied rates seem to be most satisfactory when designed and adjusted to take about 50 to 60 per cent of the air required as primary air. Efficiency and completeness of combustion are more important and a variable output of heat less important in the case of a radiant heater, hence higher percentages of primary air are employed, usually 60 to 85 per cent of that required for combustion. The demand from a water heater burner does not vary greatly, efficiency is important, and the size and form of the burner are not closely limited. For these reasons it would be best to design the burner of a water heater for high primary air; but the inferior care given to such a burner, the fact that it is not under frequent observation and is often lighted and extinguished automatically result in the need for greater safety from the danger of an unstable flame. The consideration of safety has usually prevailed, and the average water heater burner probably takes less primary air than the average range burner. In such a case as that of the burner for an unvented "gas-steam radiator", in which efficient transfer of heat is not very important and an abundance of secondary air is always present, the amount of primary air makes little difference provided it is sufficient to prevent a luminous flame and the liberation of carbon.

Efficiency and Burner Design

The effect of *designing* an appliance to take high primary air must not be confused with the effect of *adjusting* an appliance to take high primary air; the effects on efficiency are usually exactly opposite. Designing an appliance to take more primary air increases efficiency because it permits the closer confinement of the flame and a reduction in the total amount of air which carries away heat uselessly; it is effective in thus increasing efficiency only when accompanied by other changes in construction which it makes possbile. Adjusting a completed appliance to take more primary air does not materially change the secondary air or the application of the flame, and usually reduces efficiency. In the interest of efficiency an appliance should therefore be designed to take as much primary air as possible without danger from unstable flames, and when placed in service it should be adjusted to take as little primary air as possible without creating a hazard or a nuisance because of incomplete combustion. This should not be interpreted as a general recommendation that appliances be adjusted to have very low primary air, since the beginning of incomplete combustion is hard to judge and the small gain in efficiency does not warrant incurring the risk of it. The adjuster should, have in mind the effect on efficiency of changing primary air, and the conditions which limit desirable changes in both directions.

(Continued in June Issue)

Industrial Furnaces For Gas

IV-Heat Treating Pot Furnaces

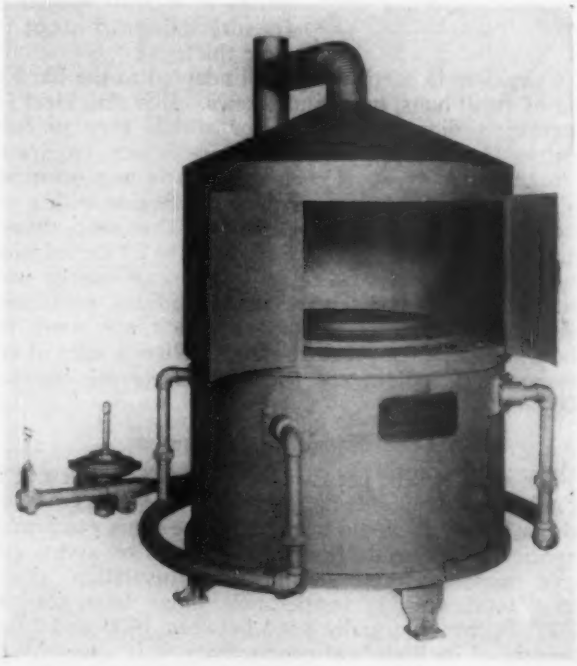
LAWRENCE E. BIEMILLER

Supervisor Fuel Sales, Consolidated Gas Electric Light and Power Company

Rectangular Cyanide Furnace with Deep Pot

ONE of the most important uses of Industrial Gas is in connection with the heat treatment of metals, particularly steel. The development of the modern automobile and the latest machinery has been possible largely as a result of the physical characteristics given the metal of which it is made by subjecting it to heat treatment. Before discussing this subject it is necessary to define some of the terms applied to the heat treatment of metals, particularly steel. Some of the more important of such terms are as follows:

Heat Treatment—An operation or combination of operations, involving the heating and cooling of a metal or alloy in the solid state. This is for the purpose of obtaining certain desirable properties.



Cylindrical Cyanide Furnace

Quenching—Rapid cooling by immersion in liquids, gases or solids.

Annealing—Heating and cooling operation of a material in solid state.

Full Annealing—Uniform heating above the upper critical temperature range, holding above that range for a proper period of time, followed by slow cooling. This is for the purpose of reducing hardness and relieving strains.

Normalizing—Heating iron base alloys above the critical temperature range, followed by cooling to below that range in still air at ordinary temperatures.

Tempering (also termed Drawing)—Reheating after hardening to some temperature below critical temperature range followed by any desired rate of cooling. Purpose to remove brittleness, and moderate hardness.

Hardening—A uniform heating to the proper hardening temperature and rapidly cooling in oil or water. Purpose to make tougher.

Lead Hardening—The operation of heating a piece of steel in a heated lead bath for hardening.

Carburizing—The operation of causing the absorpsion of carbon by steel when heated below its melting point in contact with carbonaceous material.

Case Hardening—Carburizing steel to a predetermined depth of case, and subjecting it to a subsequent heat treatment.

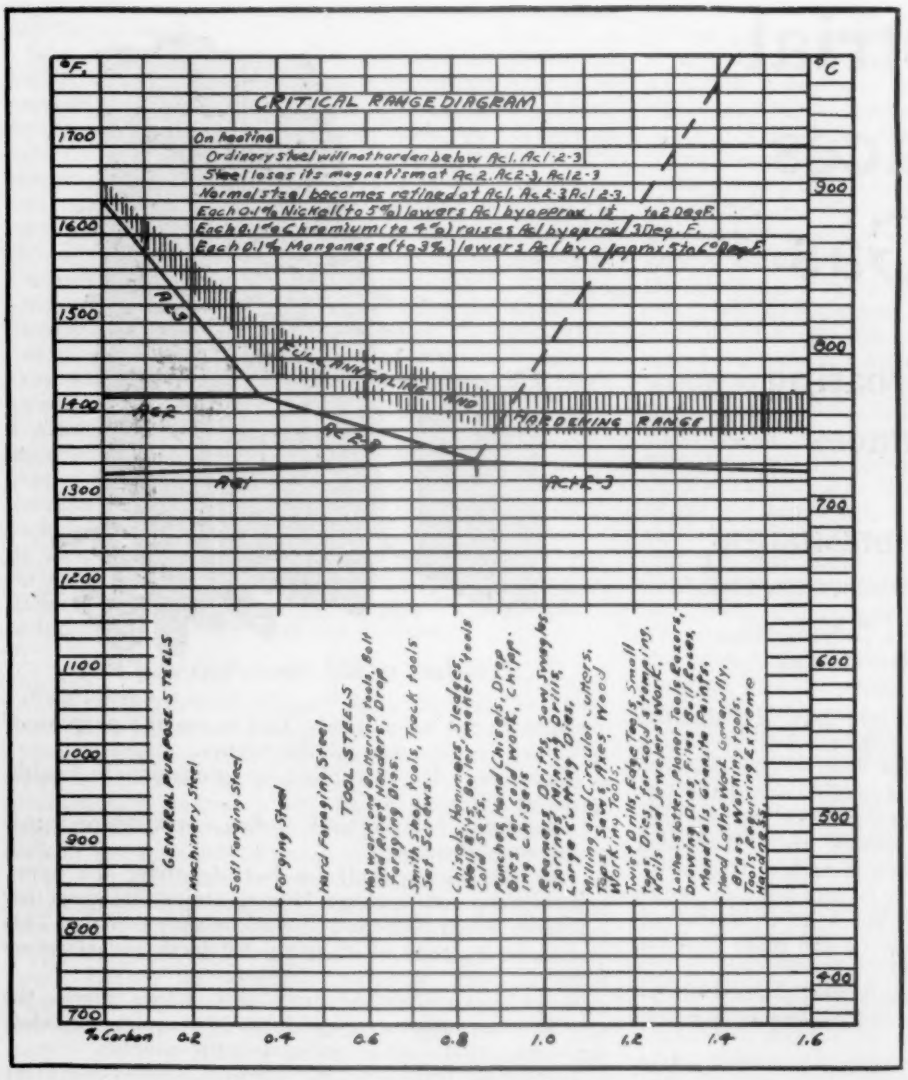
Cyanide Hardening—Carburizing steel in a molten bath of cyanide to a predetermined depth of case and subjecting it to a subsequent heat treatment.

Case—The outer portion of a carburized part that has absorbed carbon from carbonaceous material.

Core—The inner portion of a carburized part, that has not absorbed carbon from the carbonaceous material.

Critical Temperature—The temperature at which a steel has certain of its physical properties suddenly greatly altered.

The correct heat treatment of a steel is dependent upon the following:



Temperatures for heat treating different steels

1. Knowledge of the composition of the steel, upon which is dependent the critical point, and the consequent proper temperature for a given heat treatment.
2. The proper surroundings—that is, furnace atmosphere, or material in which immersed.
3. The proper temperature. For steels of different carbon contents, these temperatures are shown on the accompanying curves.
4. Even heat distribution.

In addition, the heating appliance should be one which is efficient thermally, and one which results in good working conditions for the heat treater. Because of these requirements, gas is particularly well adapted for heat treating operations, and there are many different types of gas furnaces for this purpose.

Cyanide Furnace

A cyanide furnace consists essentially of a steel pot of any shape, though usual ones are either cylindrical or rectangular, in which a cyanide salt is melted. This pot is incased in a combustion chamber in which the gas is burnt. The gas is preferably burnt in a relatively large number of burners so as to secure even heat distribution with minimum strain on the pot. These burners are located quite close to the top of the furnace, and this aids in securing heat transfer which is relatively difficult due to the low conductivity of cyanide salts.

The salt used in these baths is a mixture of sodium cyanide, sodium carbonate, and sodium chloride, in varying proportions. Its melting point varies from 1040° to 1160° F., and it is usually held at a temperature of around 1600° for carburizing. The depth of case is dependent upon the steel, and the length of time in bath. For a typical steel, the depth of case varies from .02 inches with one hour's heating to .04 with three or four hours heating. Most cyaniding is done with less than one hour's heating.

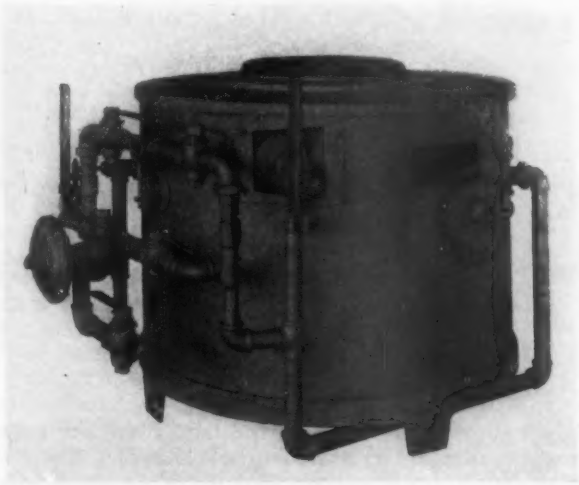
Since the fumes from cyanide furnaces are very poisonous, it is absolutely essential that they be equipped with hoods which are well vented. Cyanide furnaces are equipped with burners using either high pressure gas or air and gas under pressure. A pot 10 inches in diameter and 16 inches deep will have burners of about 200,000 B.t.u. capacity. Due to the resultant fairly high combustion chamber temperatures, it is desirable that such furnaces be well insulated. Well constructed furnaces will have from 2½ to 4½ inches of Sil-O-Cel insulation, in back of special refractory linings of about the same thickness.

Cyaniding is particularly well adapted to the hardening of small bolts, nuts, and screws. It is also ideal for engraver's dies and plates, for which very uniform heating is necessary. Some cyanided parts require oil quenching but most of such material is best quenched in cold water. Average furnace size is one with a pot about 10 inches in diameter and 16 inches deep, though rectangular pot furnaces are made up to 24 inches wide, and 24 inches deep. The same furnaces can be used with other salt baths, particularly sodium, potassium, calcium, and barium chlorides which are used for about the same temperature range. Nitrate salts of potassium and sodium are used for tempering between 400° and 1100° F.

Lead Hardening Furnace

The same type of pot furnace is used for hardening in a bath of lead but it is not necessary that it be equipped with a hood. It would have about the same gas burner capacity as a cyanide furnace of equal size, and would have similar refractory lining, and insulation. Lead has a total working temperature range from 650° to 1700° F., but is usually used between 1400 and 1700. Because of its high heat conductivity, it is adaptable to rapid heating, high output, uniform bath temperature and high thermal efficiency. It, however, oxidizes very

readily, and must have its surface covered with a coating of charcoal or special salt. The average furnace size is about the same as that of a round cyanide furnace.



Lead Hardening Furnace

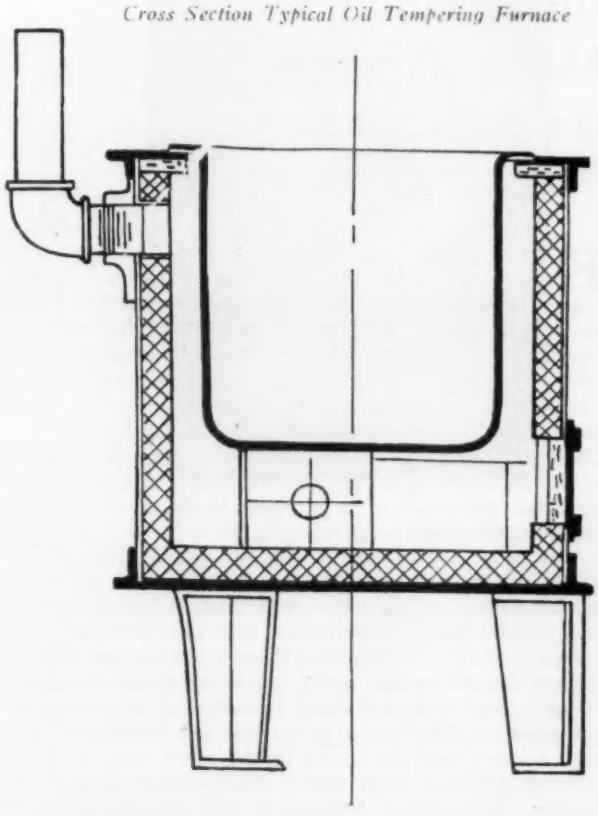
A large variety of work can be done in a lead bath. It is particularly good for selective hardening where only the ends of a piece are to be hardened. The piece being hardened should be allowed to remain in the lead only long enough for the piece to become heated through to the center.

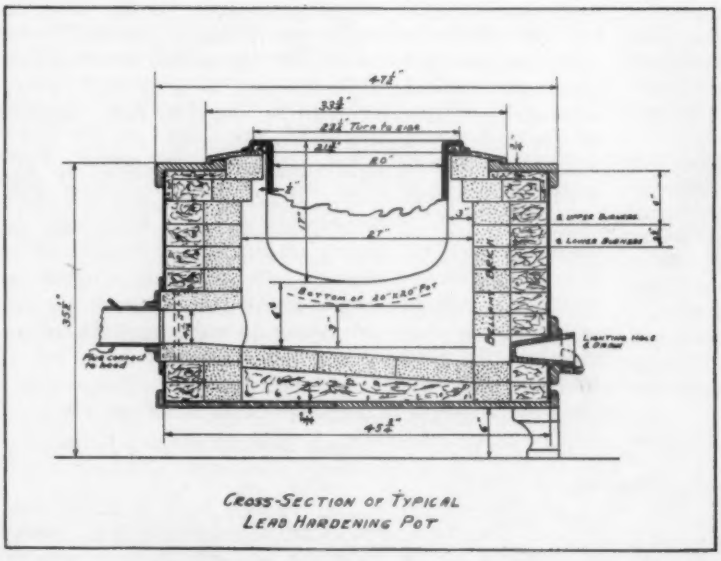
Oil Tempering Furnaces

Much material which has been hardened, particularly high speed steel, must be tempered after quenching to relieve its brittleness. This is done at temperatures from 250° to 600° F., in oil, or at temperatures from 600° to 1100° F., in nitrate salts, as previously mentioned.

Due to the lower temperature of operation, an oil tempering furnace will have only about ⅓ the burner capacity of a lead or cyanide of the same size. For the same reason it does not have special insulation, but usually a rammed lining which has some insulating value in addition to its value as a refractory. Usually there will be only one or two burners, utilizing high pressure gas or air and gas. Oil tempering furnaces are made both circular and rectangular, the former averaging about 15 inches diameter and 12 inches deep, and the latter about 18 by 24 by 18 inches.

Cross Section Typical Oil Tempering Furnace





CROSS-SECTION OF TYPICAL LEAD HARDENING POT

Temperature Control on Pot Furnaces

All the pot furnaces previously discussed, whether for carburizing, for hardening, or for tempering, function more satisfactorily when equipped with efficient automatic temperature control. It is very desirable that a proportional mixing type of combustion system be used. In order to obtain long pot life it is essential that the gas burners be of such a number and so located, a to give a very even heat distribution with lowest possible temperatures on the outside of the pots. Most of such pots are of sizes such that it is easy to demonstrate the increased efficiency of gas over liquid and solid fuels. Results comparable with those of the most efficient electrically heated pots are obtained from gas fired pot which are well insulated, have even heat distribution, and are equipped with efficient temperature control equipment.

Housecooling Investigation Makes Progress

EUGENE D. MILENER

Industrial Research Representative,
American Gas Association

North Chicago home with parctical house-cooling installation

FOLLOWING over two years' preliminary research and development work in the application of gas cooling and summer air conditioning, the work has advanced to the point where three practical installations will be made and operated under practical test conditions through the coming season This announcement, which was made by Mr. F. J. Rutledge Chairman of the Committee on Industrial Gas Research of the American Gas Association, indicates that the most important milestone in recent years in the development of gas utilization has been reached.

The three houses will be located in different sections of the country so as to get a good cross section of the air conditions. One will be on the Atlantic seaboard, one will be in the middlewest and one will be in the extreme south. In this way three separate and distinct climatic conditions will be encountered and the maximum of knowledge will be gained from operation during the first season. The houses in the east and middlewest have been selected and the house in the south will be finally selected within a short time. The eastern house is located in Westchester County, N. Y., and is typical of the well developed home life in that prosperous community. The middlewestern house is situated in North Chicago. It is a new brick dwelling and is located in a place directly exposed to the intense heat of the sun. Both houses are now heated with gas and with the addition of gas operated cooling and dehumidifying, they will become the first houses to be completely air conditioned with gas the year round.

The system that has been developed for using gas for this purpose is known as the Silica Gel gas air conditioning process. For over two years the Research Committee has actively cooperated in applying Silica Gel to summer air conditioning. Very encouraging results have been secured and last summer a large bank building was successfully air conditioned with gas. The principles developed during these last two years will be used, with modifications and improvements, in conditioning the three houses as part of the American Gas Association research.

The Research Committee believes that there is no more important new use for gas than that of building cooling and summer air conditioning. While the exact load characteristics of this class of business are not definitely known at this time, it is known that every foot of gas sold by this means will definitely counteract the growing winter peak load caused by residential, commercial and industrial building heating.

Heating and humidifying as well as cooling and dehumidifying require energy. Energy for heating and humidifying is being furnished by gas heat in all sections of the country at an increasing rate. Furnaces using gas are now manufactured that clean, circulate, heat and humidify the air and thus render a complete *winter* air conditioning service, that is, they completely condition the air when the temperature and humidity is below the zone of human comfort. The list of appliances approved by the American Gas Association Laboratory shows that nine manufacturing company members of the American Gas Association now offer gas furnaces approved by the American Gas Association Testing Laboratory that completely condition the air in *winter* time or offer the necessary standard accessories to be added to their furnaces to give complete winter air conditioning.

Research has brought summer air conditioning with gas to the practical stage. It is expected that before the summer of 1932, arrangements will have been made for manufacturing and placing on the market equipment for interpreting these processes. In order that as much experience as possible can be gained this summer the Research Committee is projecting its work from the laboratory into the field. Results of this field work will be made available to the gas industry and will serve as a background for sales campaigns, and as a basis for properly servicing equipment.

We Learn by Experience

THE following rather unusual accident was recently reported by a gas company, and we are spreading the news with the hope that a fore-knowledge of what might happen may prevent similar accidents in your company.

"Gas heating equipment had been installed in a home where coal had formerly been used. The chimneys, as might be expected, were lined with soot. The gas heat dried the soot and it fell so as to stop the further passage of the flue gases. Carbon monoxide gas, instead of escaping up the chimney, was forced back into the house, causing the asphyxiation of several people. No one was seriously harmed due to the prompt action of the gas company employees."

The company having this experience has established the practice of notifying all customers, who are changing from coal to gas fuel, that they must have their chimneys cleaned before the company would turn on gas for the furnace.

—*National Safety Council.*

Here's How

on Selling Fireplace Equipment
W. C. Evans Offers Some Sound Advice

FIREPLACE equipment occupies a most unique position in the sale of gas appliances. The art of salesmanship is more clearly expressed in taste, tact and resourcefulness than in any or all other departments of the gas appliance industry.

It is within the power of the salesman, himself, as to whether he makes or mars his future in this department by the way he handles his trade and himself.

Floor sales that are made to a buyer who gives you the measurements of his fireplaces, which may be any where from 28 to 42 inches in width and of similar height, and makes his selection of a coal or log fire too small, if he is guided solely by price, or, one too large if he is of the more liberal type—if you permit him or her to buy without first having the knowledge as to whether it is a dummy or open flue, or, as to whether it is of Italian, Spanish or English design; without knowledge of the type of material of which the mantle is built; with no thought of material in the lighting fixtures; no information of color-tone of that particular room's decoration; then my brother salesman, you are surely paving the highway to disaster, and you will end your present position by starting life all over again in another business.

My territory with the Oklahoma Natural Gas Corporation, Tulsa, is the heart of the best residential district of this Wonder City.

My clientele is composed of men whose salaries range from $1800.00 per annum to incomes that run into that maze of figures that make anarchists out of the leeches and leaners on the larder of life, but furnish incentive and give hope to the man or boy worth while.

My territory consists of hundreds of people who have been raised in wealth and have generations of wealth behind them, also hundreds who have had wealth thrust upon them through the wizardy of this Magic Empire—housewives who represent the last word of the most cultural finishing schools both of the old world and the new and on down to that splendid type of American Creation, the Average Man.

To successfully contact and close the sales with this amazing amalgamation of people, we must possess and fully develop the following—brains, sense of humor, tact, resourcefulness and industry.

He, who depends upon brains can never be taken at a disadvantage. Sense of humor keeps you from feeling sorry for yourself, makes play out of your work, and makes a comic picture out of a mirror. Tact is making up other people's minds for them—they take the credit but you get the money. Resourcefulness is lifting yourself by your boot-tops out of holes fools insist upon falling into.

Sales floor contact is the best starter; you may not sell the article but you must sell yourself and make inspection appointment, residential address and telephone number included.

Make telephone calls, especially of evenings, inviting visits to the sample floor and offering to call personally to advise or suggest. Cold canvas is good and must be consistently done, but discriminating buyers must be handled differently, each according to type.

To call and gain entree as a mechanic is to my mind wrong, especially on fire place equipment. Personally, I always enter the front door. I am my Company so far as the situation at hand is concerned, and I try to handle myself in such a way that the lady would be reluctant about asking me to adjust her water heater or furnace. Always try to make the appliance conform with the surroundings, tastefully and harmoniously and then price it, but don't let your suggestions be based on

FORM 501-2SM-10-30-PETROL See Range Card.

OKLAHOMA NATURAL GAS CORPORATION

APPLIANCE PROSPECT

NAME Mrs Johyn Doe PHONE 4-8265

ADDRESS 2248 E Quincy APARTMENT

INTERESTED IN Living Room 2-26 B. Has new Andirons

Library " 07 Oak Log (Dark Oak)

REMARKS: Daughters " 03 Birch Log (Bird's Eye Maple)

REPORTED BY Self DEPARTMENT Sales

DATE REPORTED Oct. 8 SOLD BY Self DATE Nov. 2

REPORT

CALL	PHONE	LETTER	DATE	RESULTS	SALESMAN
1			10-8	Inspection & Suggestions (male)	
	1		10-20	Phoned for appointment	Nov. 1
				Sold Nov. 2	
				Evans	

Obverse and reverse of typical salesman's prospect card

price. Do not have mental clashes with women who run high in self appraisal.

Lead, but appear to follow.

If impatience threatens to overcome your better judgment, let the thought die in that strange interlude—the embryo of thought—before the spoken word.

Know your line. Be yourself at your best. Be an artist in the painting of word pictures.

And when you have closed the sale, whether for one or ten coal or log-fires in a home, you may feel justly proud, not of commissions only, but the fact that your personality is reflected in the best homes in the city that you honor with your presence.

And when the proud owner of these well selected appliances sits back in his home on the cold winter evenings, and thinks that all of the rest of the world, like he, is warm, back in the recesses of his mind will be memories of you. And while the lights are turned down low, in the soft glow and warmth of a gas coal fire he plans the celestial and terrestrial problems of the coming day. And it is there many social and financial battles are fought and won.

Waste of Natural Gas in California Reduced in Year

WASTAGE of natural gas in California was reduced by 74 per cent from February, 1930, to January, 1931, according to a statement issued by the State Railroad Commission. The statement follows in full text:

During the year 1930 there was produced from the oil and gas fields of California a total of 228,099,899 barrels of petroleum and 544,765,048,000 cubic feet of natural gas, according to a report submitted to the Railroad Commission by Claude C. Brown, its chief gas and electric engineer.

Of this quantity of natural gas produced, a total of 141,384,977,000 cubic feet was delivered to distributing utilities, a total of 182,387,786,000 cubic feet was used for repressuring and storage, gasoline plant fuel and shrinkage, field fuel and drilling operations and refining fuel and the remaining 220,992,285,000 cubic feet was blown to the air and wasted.

Over this period the 21 privately owned and municipal distributing utilities sold a total of 126,175,000,000 cubic feet of gas to a total of 1,400,000 consumers throughout the State. During the year 1930, a great deal was accomplished in the cause of conservation of natural gas. This is shown by the fact that the total monthly wastage was reduced from 26,588,309,000 cubic feet in February, 1930, to 6,907,985,000 cubic feet in January, 1931, a reduction of 74 per cent.

The factors that accomplished this great reduction in wastage were the effect of the State gas conservation law known as the Lyons Act, the voluntary curtailment of production by the oil industry, the curtailment agreement between the operators in the Kettleman Hills field and the Federal Government, the tremendous expansion of natural gas service by the public utilities of the State and the natural decline in production in the southern fields.

The most important source of natural gas and petroleum in the State at the present time, and probably for some time to come, is the Kettleman Hills oil field, located in Fresno and Kings counties. This field is now producing from eight wells a total of 426,390,000 cubic feet of natural gas per day, of which 201,423,000 cubic feet per day is being taken north to San Francisco and south to Los Angeles by the distributing utilities, 69,824,000 cubic feet per day is used for storage, plant fuel, refining fuel, field operations, etc., and 155,143,000 cubic feet per day is being blown to the air and wasted. All of the gas produced in this field is passed through gasoline extraction plants from which are being produced a total of 2,087,250 gallons of natural gasoline per day.

During the next two years the construction of two new gas lines from this field are contemplated. One of these, a 12-inch line to Herndon, will supply some 12,500,000 cubic feet of gas for the operation of a 50,000 kilowatt electric steam plant at Herndon, near Fresno, and the second, a 26-inch line, will supply 130,000,000 cubic feet of gas per day to the Los Angeles Basin and the Long Beach steam plant of the Southern California Edison Company at Long Beach, Calif.

The outlook for further accomplishment along the lines of conservation are bright and it is very probable that the next few years will see substantial improvement in conditions relating to the conservation and economical utilization of our natural gas resources.—*United States Daily.*

Synthetic Hydrocarbons From Carbon Monoxide and Hydrogen

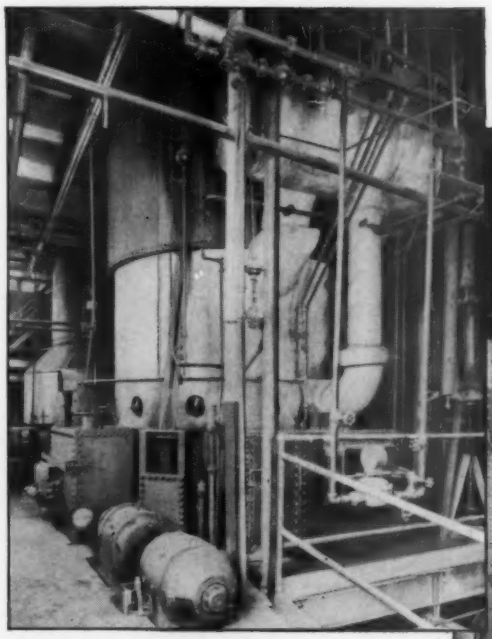
IT has been long known that methane can easily be formed from carbon monoxide and hydrogen, by passing a mixture of these gases over a suitable catalyst, at atmospheric pressure and at temperatures as low as 150° C. It is only in comparatively recent years, however, that higher members of the methane series have been prepared from carbon monoxide and hydrogen by similar methods in appreciable quantities. Consideration of the hypothetical reactions involved shows that thermodynamically the formation of higher hydrocarbons from carbon monoxide and hydrogen should proceed with greater ease than the formation of methane, and that the maximum possible yields are greater.

A rather exhaustive investigation of this process has been conducted on a small scale at the Pittsburgh Experiment Station, United States Bureau of Mines, regarding optimum operating conditions, choice of catalysts, and conditions which control yields. In this work it has been demonstrated that the extent of the conversion of water-gas to hydrocarbons can be made fairly high; and that the process can be so conducted that the major portion of the yield will be products which are liquids under ordinary atmospheric conditions. With favorable catalysts, 30 per cent conversions have been effected with one pass through the converter.

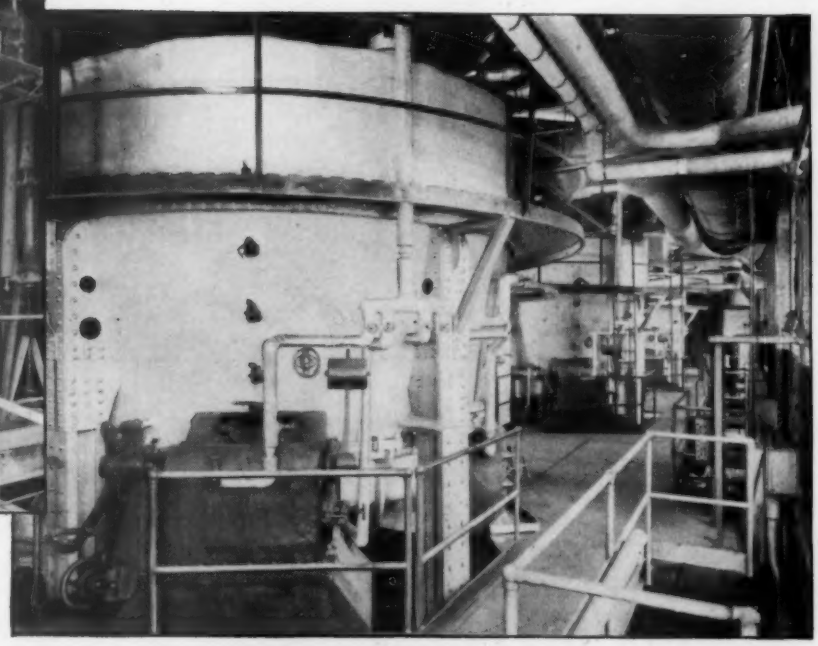
The liquid portion of the product comprises 60 to 75 per cent of the total organic products; and methane appears as a minor constituent. The liquid product consists mostly of hydrocarbons of the methane series, containing only traces of compounds containing oxygen.

Thus it has been demonstrated that a synthetic product resembling petroleum can be obtained from water-gas. This fact may in the future cause this process to assume considerable importance as an auxiliary source of liquid fuel, and may offer to the manufactured-gas industry at the present time a means of effecting enrichment and odorization of blue water-gas.

AT PHILADELPHIA



1924—First Installation in the United States



1930—Three Additional U. G. I. Mechanical Generators

THE U.G.I. MECHANICAL GENERATOR

Record of Installations and Contracts

1924	1
1927	1
1928	1
1929	11
1930	12
1931 (to date)	8
Total	34

THE U. G. I. CONTRACTING COMPANY

DIVISION OF

UNITED ENGINEERS & CONSTRUCTORS

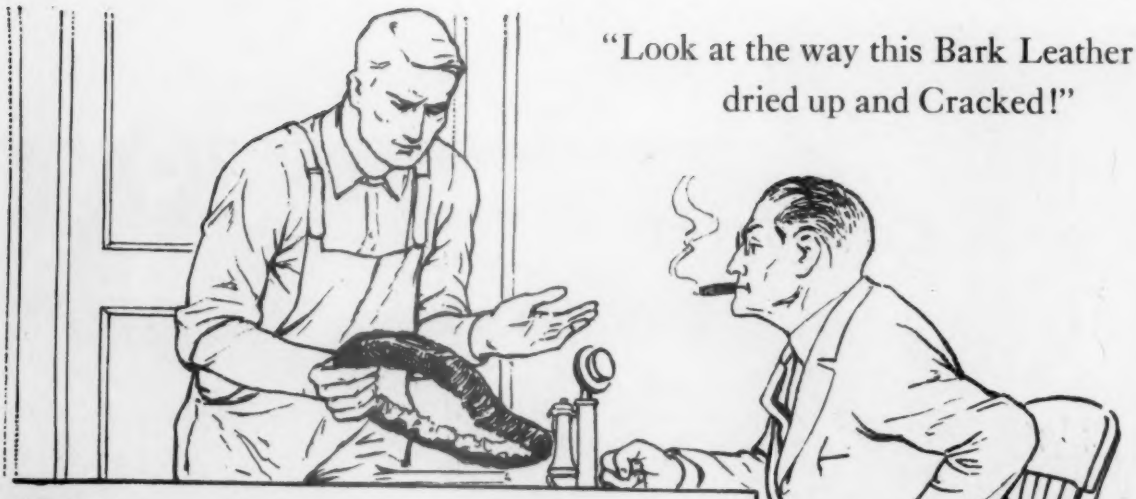
INCORPORATED

DWIGHT P. ROBINSON, PRESIDENT

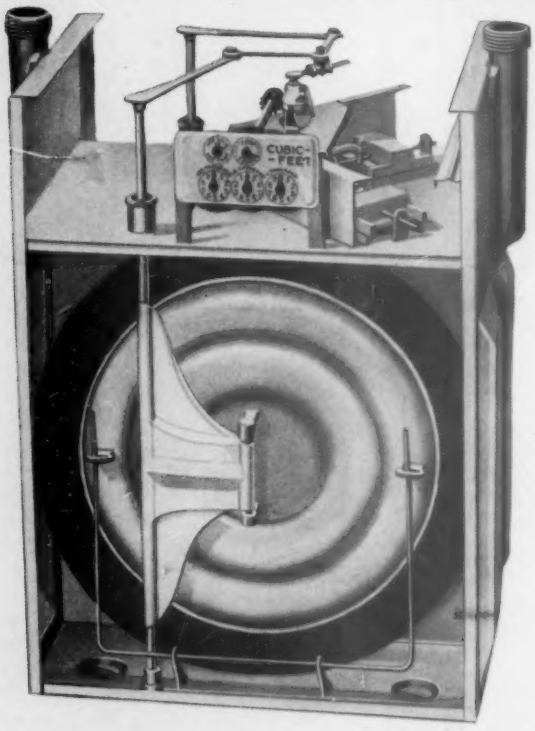
Philadelphia
112 North Broad Street

Chicago
Conway Building

MAXIMUM RETURN TO CLIENTS PER DOLLAR INVESTED



"Look at the way this Bark Leather has dried up and Cracked!"



WHY USE INFERIOR LEATHER WHEN — *You Can Use* "COLONIAL" RE-CHROME METER LEATHER IN YOUR METERS—

Colonial Re-Chrome meter leather gives longer years of service and eliminates slow and fast meters, is easier to fabricate, sew and crimp, and does away with "floppy" diaphragms. The proved performance of Re-Chrome leather justifies its use by leading meter manufacturers and gas companies.

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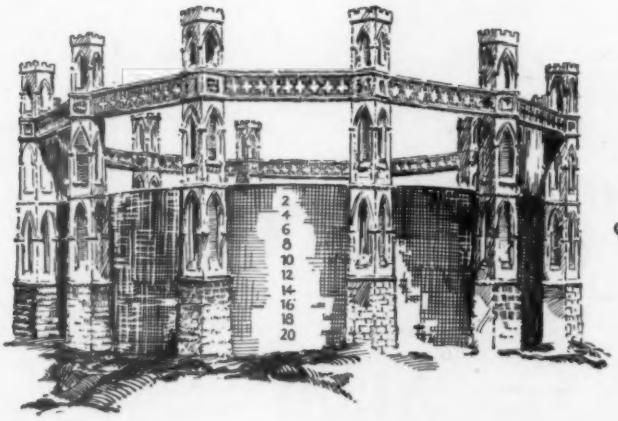

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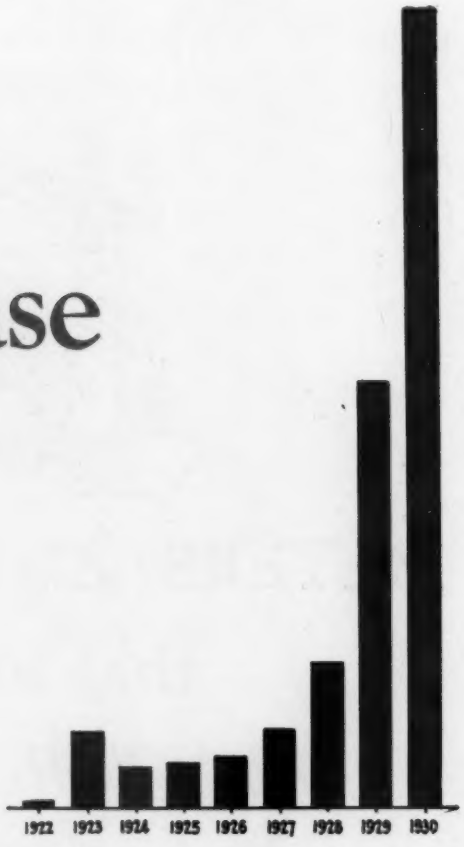

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Some Common Errors of Gas Analysis and Their Remedies

MARTIN SHEPHERD
Chemist, Bureau of Standards, Washington, D. C.

(Continued from April Issue)

Part II. An Improved Apparatus and Analytical Precedure

AN improved apparatus recently developed at the Bureau of Standards is described in this paper.[8] It eliminates many of the unsatisfactory features found in commercial forms of gas analysis apparatus, the more common of which were discussed in Part I of this paper. Distinct improvements have been made in the adjustment and control of pressure balances, the design of combustion and absorption pipettes and of the manometer-compensator, as well as in the plan of assembly and apparatus support. The unit as a whole has been made as modern as possible. It has been found more satisfactory, both as to accuracy obtainable and ease of manipulation, than other available models.

The operating technique is given in a set of simple instructions. The analysis of a common fuel gas is chosen to illustrate the analytical procedure. This portion of the paper is condensed in order that it may be presented in a space small enough to permit ready reference.

1. The Burette-Manometer-Compensator Assembly

This is illustrated in figure 3. Its various parts may be briefly described.

(a) The burette.—The burette is graduated according to the National Bureau of Standards specifications for volumetric burettes.[9] All marks are extended slightly over half way around the circumference. Graduations corresponding to odd numbered milliliters are extended three-fourths way around, and those corresponding to even numbered milliliters are extended completely around. This system of graduation produces a burette which may be read conveniently and without parallax. The system of stopcocks 2-3-4 is designed to permit the following operations:

(1) The line connecting the sampling pipette to the burette may be flushed with mercury from the burette or with a portion of the gas sample.

(2) The sampling pipette may be left connected to the burette during an analysis so that a fresh sample for check analysis is immediately available.

(3) Gas or mercury may be expelled from the burette, and water introduced, through an atmospheric outlet.

(4) The burette may be connected to the distributor, or the manometer, or both simultaneously.

(5) The distributor may be purged with nitrogen through atmospheric outlet. Thus there is no danger of contaminating a gas sample, and all the necessary connections are conveniently made.

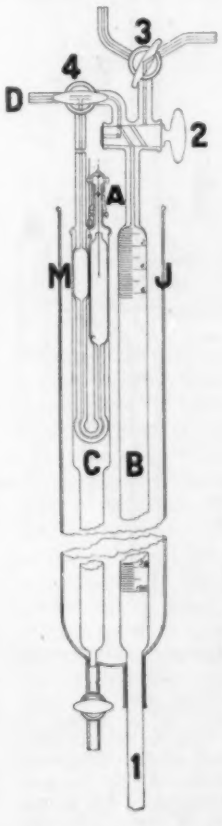


Figure 3.—The Burette-Manometer - Compensator Assembly.

The burette B connects to the distributor at D, permitting simultaneous pressure balance of D and B. The manometer M. is sealed within the compensator C. C may be connected to atmosphere through the ground sleeve A, which also supports a platinum contact point by means of which the pressure balance is indicated electrically. B, M and C are inclosed in the water filled jacket J. The special control stopcock (Fig. 4) is attached at J.

(b) Manometer-Compensator. The manometer and compensator are constructed as one unit. This presents a number of advantages. The unit is compact and may be removed from the water jacket without disturbing the burette or distributor. It is much less fragile than the usual type. Connection from the compensator to the atmosphere is made without the ordinary stopcock. Other advantages will become apparent after a study of the drawing (Figure 3.)

The balance point of the manometer is obtained by electric contact. This method was suggested by Gregg[10] and its accuracy determined by Weaver and Ledig.[11] For general gas analysis it is by far the most satisfactory means of adjusting the pressure to a zero or fixed ref-

[8] *Martin Shepherd, Bureau of Standards Journal of Research, 6, 121; 1931. Research Paper No. 266. This paper gives a detailed description of the apparatus and methods employed.*

[9] *B. S. Circular No. 9, p. 5.*

[10] *J. Ind. Eng. Chem., 9, p. 528; 1917.*

[11] *J. Am. Chem. Soc., 42, p. 1177; 1920.*

Publication approved by the Director of the Bureau of Standards, Department of Commerce, Washington, D. C.

erence point with respect to both accuracy and ease of manipulation. A platinum lead is sealed into the bottom of the arm of the manometer adjacent to the compensator and passes through a small tube in the dome of the compensator. A platinum contact sharpened and polished to a needle point, is supported by the sleeve *A* so that it centers within the same arm of the manometer. as shown in the drawing. Mercury is used as the manometer fluid. When the mercury meniscus rises to touch the point of the contact an electric circuit, including a miniature lamp, is closed and indicates the balance point. The balance is obtained by allowing the mercury to flow upward toward the platinum point—never the reverse. The mercury in this arm of the manometer adjacent to the compensator is not in contact with stopcock lubricant and will remain clean for considerable periods. A 3-volt battery supplies the power and a 6.5 μf condenser is placed across the leads to prevent arcing. Under these conditions the platinum contact will not foul. The very slow formation of a platinum amalgam makes it necessary to remove the point for cleaning once or twice a year. To do this it is only necessary to remove the supporting sleeve *A*. Any significant capillary error has been avoided by making the manometer arms from tubing of 9 to 10 mm. inside diameter.

(*c*) *Pressure control*—In order to transfer gas from one part of the apparatus to another and to balance the manometer, some method of pressure control is necessary. This usually consists of a vertical movement of the leveling bulb which supplies the confining fluid to the burette, and this adjustment is ordinarily made by raising and lowering this reservoir by hand or by some gear system. The latter is cumbersome, and the former both awkward and inaccurate.

Many years' use of the following method has shown it to be simple and accurate. Four rings are fixed to the frame supporting the apparatus. When the leveling bulb is placed on the uppermost of these rings and the burette opened to the atmosphere, mercury from the bulb will completely fill the burette. When the bulb is placed on the lowest ring and the burette opened to the atmosphere, the mercury within the burette will fall to a level below the 100 ml mark. The remaining two rings are fixed at equal distances between the first two. Mercury may then be introduced or withdrawn from the burette by placing the leveling bulb on the proper ring. The pressure control is obtained by regulating the rate of flow of mercury into and out of the burette. This is accomplished by interposing special control stopcock[12] between the burette and the mercury reservoir.

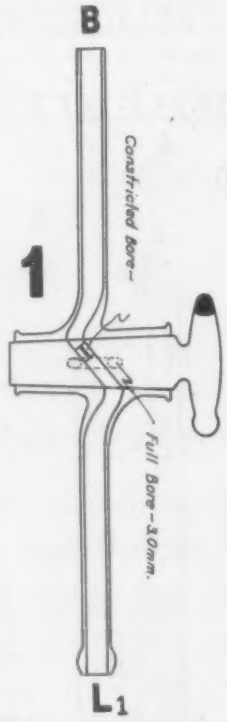


Figure 4.—The control Stopcock

The stopcock connects to the burette at B and to the levelling bulb at L₁. Length of barrel, 40 to 43 mm. Diameter of key at center, 14 mm. The constriction is 2 to 3 mm in length and will pass a wire 0.125 mm in diameter, but will not pass a wire 0.15 mm in diameter.

The stepcock is illustrated in Figure 4. The key of this cock has two bores, one of which is provided with the fine constriction shown. Rough adjustments are made through the large bore, following which a 90° turn of the key admits an extremely slow flow of mercury to the burette.

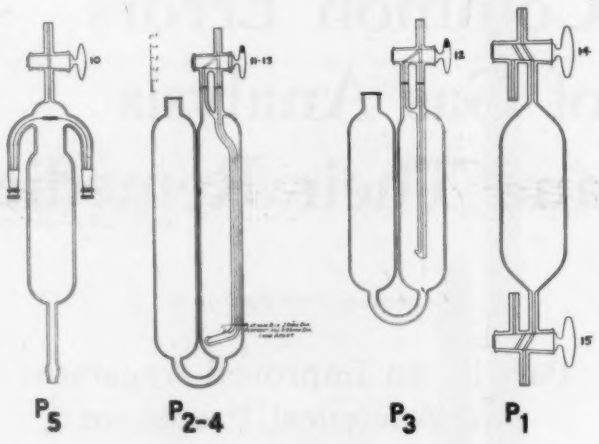


Figure 5.—The Pipettes

P_5—The sampling pipette

Capillary tubing of stopcock 14, 7 mm o. d. x 1.5 mm i. d. Tubing of stopcock 15, 7 mm o. d. x 4 mm i. d. Length of bulbed portion, 150 to 155 mm. Over-all length, 290 mm. Capacity, 2-sample size, 220 ml. Capacity, 3-sample size, 330 ml.

P_3 and P_{2-4}—The absorption pipettes

The plain bubbling pipette for less difficult absorptions is P_3, and the "distributor" pipette for difficult absorptions is P_{2-4}. The etch marks on the capillary steams are 15 mm below the bottom of the stopcock. The capillary outlet should be ground flat and slightly beveled at the outer rim. Length of barrel of stopcock, 35 mm. Diameter of key of stopcock, 12.5 to 13 mm at center. Capillary bores, 2 to 2.5 mm.

P_1—The combustion pipette

Capacity, 150 ml. Outside diameter of large section, 38 mm. Outside diameter of top section, 26 mm. Made from Pyrex glass.

In balancing the manometer the mercury can be quickly raised to within a millimeter from the contact point. The constricted bore is then opened to complete the balance, the mercury rising so slowly toward the contact point that the eye is unable to determine when actual contact has been made until the circuit is closed and the lighting of the miniature lamp reveals it. By selecting the proper one of the four supporting rings for the leveling bulb the operator can maintain a roughly equal head of mercury, so causing a fairly uniform rate of flow of mercury in the manometer. When the contact has been made another 90° turn of the key closes the stopcock. The time lag in closing the cock after contact has been made should result in no significant error, because of the uniform and very slow rate of flow of the mercury.

The control cock is also used to regulate pressures and rates of gas flow within the rest of the apparatus. It is necessary to displace the gas confined within the arm of the manometer connected to the burette and the distributor before passage to any of the pipettes, thus eliminating the errors which will otherwise arise from diffusion of gases into the manometer. The thread of

12. Described in detail in a note, a Simple Control Stopcock for Gas Analysis Apparatus, by Martin Shepherd, B. S. Jour. Research, 4, p. 23 (Research Paper 130); 1930. The size of the constriction is important, and directions for making the cock should be consulted before attempting its construction.

mercury in the capillary exit of the manometer may be safely raised to the bore of the connecting stopcock (*4* of fig. 3) by using the constricted bore of the control cock. There is thus no danger of emptying the mercury from the manometer into the distributor. The same control is used in displacing gas from the pipettes. It is possible to bring the reagents within the pipettes to etched marks on the capillary exits without danger of drawing reagent into the distributor.

2. Pipettes

(a) Absorption pipette.—The bubbling type pipettes shown in figure 5 (P_3 and $P_{2\text{-}4}$) are used. P_3 is for less difficult absorptions, such as carbon dioxide in potassium hydroxide. The pipette $P_{2\text{-}4}$[13] has a perforated platinum disk sealed into the gas inlet. This disk is drilled with holes 0.06 ± 0.005 mm. in diameter, spaced 1 mm. apart. The burrs resulting from drilling are not removed and are placed on the efflux side of the plate. The gas inlet tube is dish-shaped and is placed at an angle in order to prevent trapping the return gas.

There are over 200 small orifices in such a plate, and the gas issuing is broken up into many fine bubbles, which apparently do not coalesce. A pressure of about 30 mm. of mercury is required to force the gas through the perforated plate. A 100 ml sample may be passed into the pipette in about 20 seconds. Reaction is very rapid, and the pipette is consequently used for difficult absorptions. The difference between the two pipettes is illustrated by the fact that the removal of oxygen from air by alkaline pyrogallol required 10 passages into P_3 and only 2 into $P_{2\text{-}4}$. In ordinary practice, however, 3 passages into $P_{2\text{-}4}$ are recommended, since the distributor space may be large enough to make this necessary.

(b) Combustion pipette.—The Weaver and Ledig combustion pipette,[14] illustrated in figure 5 (P_5), is used.

It eliminates the many undesirable features of the type in common use. It is made of Pyrex glass, has a volume of approximately 150 ml and is used with mercury as the confining fluid. The platinum combustion coil is strung through two side arms which are tapered slightly at the end. Steel caps terminating in ordinary binding posts are fitted to the outside of this taper.

To place the combustion coil within the pipette and secure it is a perfectly simple operation, requiring but a few minutes time. About 20 turns of the platinum wire are wound snugly around a stiff wire of approximately 1.5 mm diameter. About 8 cm of wire is left at each end of the coil. The coil is removed from the form upon which it was wound, and one of the projecting wires is bent slightly. The whole may now be easily strung through the side arms, leaving the uncoiled ends projecting therefrom. These are grasped between two fingers of each hand and the coil is stretched until it just extends across the dome of the pipette. The ends projecting from the side arms are now bent sharply upward around these arms. This holds the coil in place until the caps are slipped over the tapered ends of the side arms. The caps are cemented in place with DeKhotinsky cement. If it becomes necessary to replace the coil, one has simply to warm the caps, remove them, thread through a new coil, replace the caps and again warm them gently to secure theDeKhotinsky seal.

When the pipette is first filled, mercury falls into the side arms and makes the electric contact between the caps and the combustion coil. These arms are of sufficient length to dissipate the heat from the dome of the pipette, so that the cement is not softened.

(c) The Sampling Pipette.—The sampling pipette used is similar to the standard type constructed with two so-called "3-way" stopcocks, as shown in Figure 5 (P_1). The convenience of this arrangement is at once apparent. The sampling line may be flushed with the sample itself or with a confining fluid when the sample is taken. Similarly, the same operations may be performed after the pipette is connected to the burette. And, finally, air may be displaced from the tubing connecting the leveling bulb containing the displacing fluid. The identity of the sample is thus preserved at all times and with no extra trouble.

The capillary exits at the top and bottom are of different bores, and are designed to accommodate the flow of gas (top) and confining fluid (bottom). The capacity of the pipette is large enough to provide three samples for analysis.

3. The Distributor

The usual nitrogen filled distributor has been selected, since it is better adapted to the work expected from this type of apparatus. This is shown in Figure 6. A series of tee stopcocks (*5* to *8*, inclusive) permits the gas

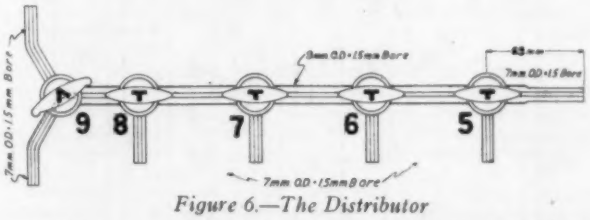


Figure 6.—The Distributor

Tolerance on outside diameter of 7 mm capillary tubing, ±0.2 mm. Tolerance on bore of all capillary tubing, ±0.1 mm. Length of barrels of all stopcocks, 33 to 35 mm. Diameter of keys of stopcocks, at center, 12.5 to 13 mm. Ends of vertical leads and of left-hand horizontal outlet to be ground flat and slightly beveled at the outer rim.

stream from the burette to be confined to only that portion of the distributor which leads directly to the pipette into which the gas is to be introduced. This eliminates to a large extent capillary dead spaces. A 120° cock (*9*) placed at the end of the distributor permits connection to the atmosphere, an auxiliary source of nitrogen, or acidulated water if the distributor is to be flushed in situ. The latter technique is somewhat objectionable. It becomes necessary only when a reagent is accidentally discharged into the distributor, a catastrophe which may easily be avoided when the pressure control already described is used. And in the event the operator inadvertently brings this calamity upon himself the distributor should be dismounted and properly cleaned. Flushing in situ is at best an expedient to be used only in special cases. An alkaline reagent will ruin the grinding of the distributor stopcocks and should be washed out immediately. It is also obvious that even traces of a reagent in the distributor will spoil an analysis.

The distributor may have as many tee stopcocks as the type of analysis demands. Thus additional pipettes, etc., may be accomodated if needed.

The bores of the stopcocks and distributor are important. These are made as small as possible without introducing the danger of periodically plugging the bores with lubricant. The outside diameters are also important, and it will be noted that the distributor is stronger

[13] *Martin Shepherd, A Gas Analysis Pipette for Difficult Absorptions, B.S. Jour. Research, 4, 747; 1930*

[14] *E. R. Weaver and P. G. Ledig, Ind. Eng. Chem. 12, 368; 1920.*

than the usual type. The dimensional tolerances given in Figures 8 and 1 may seem severe, but they have resulted from long and not always happy experience. The right-hand exit of the distributor connects to the outlet of stopcock 4 of Figure 3, and preferably should be made from the same piece of capillary tubing, ground flat and slightly bevelled, as was previously specified in the case of the capillary exit of the manometer.

The distributor should be calibrated so that the volume of each section is known. The use of the calibrated distributor is discussed in detail on pages 158-166 of Bureau of Standards Research Paper No. 266, and it may be used to greatly shorten the analytical procedure for so-called exact analysis. An example of its use will be given at the end of this paper.

4. The Assembly

(a) Arrangement of parts.—The assembly of the gas analysis unit is shown in figure 7. A brief study of the assembly drawing will afford a preliminary picture of the apparatus as a unit.

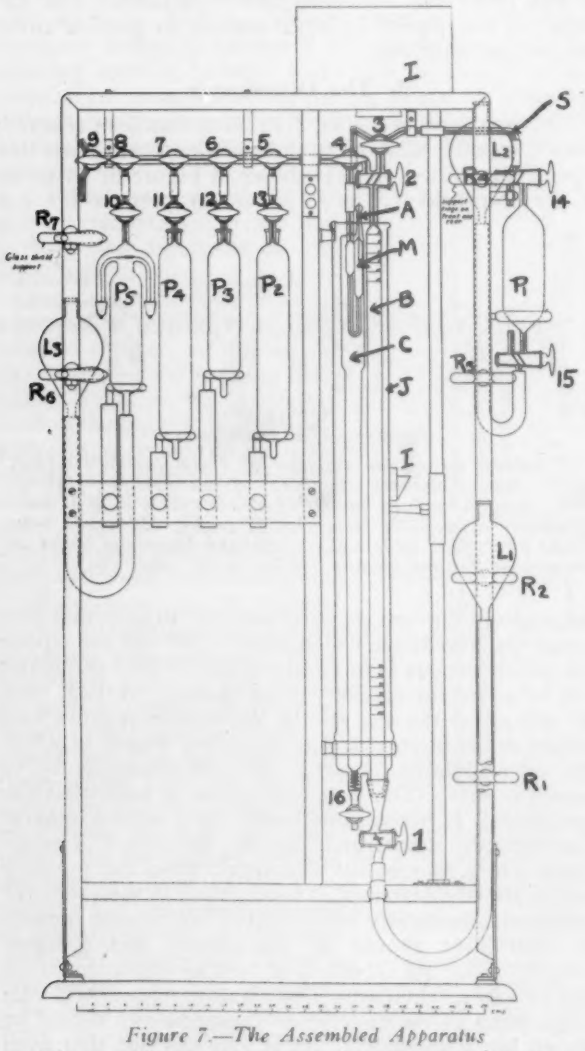


Figure 7.—The Assembled Apparatus

The assembly of the gas analysis unit for examination of fuel gases.

For convenience the various parts have been lettered to correspond to the detail drawings which have preceded. The designations of the various parts are classified as follows:

Numbers indicate stopcocks.

Capital letters indicate major parts of the apparatus:

B is the burette. C is the compensator. I is the burette illuminator, J is the burette water jacket. L_{1-3} are leveling bulbs. M is the manometer. P_{1-5} are the pipettes. R_{1-7} are rings which support the leveling bulbs. S is the sampling connector.

The burette is placed at the right so that the manipulation of the important stopcocks 1, 2, 3, and 4 and the leveling bulb L_4, is natural to a right-handed operator. It will be remembered that the leveling bulb is never held in the hand during a pressure adjustment or transfer of gas, so that its manipulation does not interfere with that of the stopcocks. If the operator is left handed, a mirror image of the present model would be more suitable for his use.

The sampling pipette P_1, which is a nomadic part of the unit, is mounted just outside of the frame proper and to the right of the burette, where a connection is easily made. Its leveling bulb is supported on the ring R_5, which is mounted on the back of the frame and is open at the side.

For an analysis such as will be described to illustrate the use of the apparatus, the adsorption pipettes are arranged in the following order:

P_2 contains fuming sulphuric acid
P_3 contains a potassium hydroxide solution
P_4 contains an alkaline pyrogallol solution
P_5 is the combustion pipette

The leveling bulb L_3 connected to the combustion pipette is supported on the rings R_6 and R_7, which are open at the side and mounted at the back of the frame. A shield of nonshattering or laminated glass is mounted on hinged brackets secured to the front of the frame. This shield serves as an explosion guard which may be swung in front of the combustion pipette. When not in use it swings aside and out of the way.

(b) Apparatus support.—This consists primarily of a frame made from ¾ inch angle iron. The top and sides are bent from a single section and the cross pieces are riveted to them. The whole is mounted on a cast iron base. Gusset plates at the bottom and the cross pieces secure the necessary rigidity. This type of support is superior to the usual wooden mounting. It is free from warping and makes the apparatus much more accessible.

The water jacket rests in the ring and is secured at the top by two friction clips. The sampling pipette rests on a split ring and is held at the top by a friction clamp. The absorption and combustion pipettes rest on split rings, which are mounted on sliding supports secured to the crossbar.

A detail drawing of the pipette support is given in figure 8. The rings are secured to the sliding supports by machine screws, and are, therefore, adjustable to accommodate pipettes of various widths. The sliding supports are guided by the grooved pieces F_9 and secured in place by the set screws F_{10}. The spacers F_{11} fix the crossbar F_4 at the proper distance outward from the frame, so that the pipettes may be connected to the distributor without off-set. The whole pipette support is chromium plated.

The apparatus support is designed to permit the removal of any part of the apparatus without disturbing other parts. The glass parts are so easily accessible that it is possible to completely assemble or dismount the apparatus in a few minutes.

Further details of the apparatus support, as well as the general assembly plan, are illustrated in the photograph of the laboratory model (Fig. 9) and the special model (Fig. 10). The arrangement of the pipettes differs from that shown in Figure 7, and is applicable to general analysis rather than to the examination of fuel gases. The arrangement given in Figure 7 is the only one discussed in this paper.

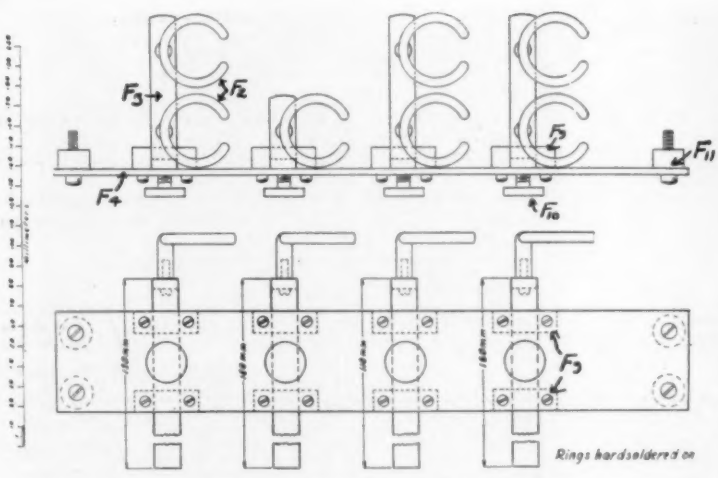


Figure 8—The Pipette Support

The rings F_2 are secured to the sliding supports F_3 by machine screws and are, therefore, adjustable to accommodate pipettes of various widths. The sliding supports are guided by the grooved pieces F_9 and secured in place by the set screws F_{10}. The spacers F_{11} fix the crossbar F_4 at the proper distance outward from the frame, so that the pipettes may be connected to the distributor without offset. The whole pipette support is chromium plated.

Condensed Operation Technique

The technique for each general operation will be given. Refer to Figure 7.

1. Sampling.—First be sure that the sample to be taken will give the information desired.

Fill P_1 with mercury from L_2, excluding air bubbles from rubber connecting tube. Connect upper outlet of 14 to source of sample. Turn 14 to connect source to atmosphere and flush sampling line with the gas. Turn 14 to P_1 and take in sample under slight pressure. Close 14 and 15 and transfer P_1 to apparatus.

2. To transfer a sample to burette.—Connect P_1 to B at cock 3 with tube S. Turn 14 to connect S to atmosphere. Place L_1 on R_4, open 1, and allow mercury from B to displace air through 2-3-5-14. Close 1, turn 14 to P_2, place L_1 on R_2, open 15, open 1 slowly and take in sample.

If L_2 has been disconnected from P_1 in transferring to apparatus, replace, and displace air from connecting tube with 15 turned to atmosphere.

3. To transfer gas from the arm of the manometer connected to the distributor.—To avoid upsetting manometer, adjust pressure in B to approximately atomspheric before connecting M to B. To do this, close 2, open 1, and adjust L_1 until the mercury in B and L_1 are roughly at the same level. Close 1.

Close all pipette cocks. Turn 2 to 4, and 4 to ⊢. Place L_1 on R_1. Slowly open 1. Mercury will rise in M toward cock 4. As mercury approaches 4, turn 1 to constriction. Close 1 when mercury reaches bore of 4. Turn 4 ⊥.

4. To fill the distributor and manometer arm connected thereto with nitrogen.—Displace gas from the manometer arm connected to the compensator, according to technique given in preceding section 3.

Draw about 100 ml of air into B through 3 and 2. Transfer this to P_4 (containing alkaline pyrogallol solution) according to technique given in section 6 which follows, and absorb oxygen from air according to procedures given in section 7 as modified by section 8. When oxygen is absorbed, pass residual nitrogen into P_2, thence to B, then into P_3 and back to B, then twice into P_4 and back to B. Leave reagents in $P_{2,3}$ and $_4$ adjusted to etched marks on capillary stems, cocks 13, 12 and 11 closed and cocks 5 and 6 turned ⊥. Lower L_2 to R_6, open 10, turn 8 ⊢, turn 7 ⊥ and transfer about 50 ml of N_2 from to P_5. Close 1 and 10, turn 8 ┤, raise L_2 and expel N_2 from P_5 until mercury reaches bore of 10. Turn 8 ⊢ and close 10. The system now contains nitrogen. Turn 4, 5, 6 and 7 to ⊤. Open A to the atmosphere. Complete the pressure balance according to the technique given in section 5. Close A.

The distributor and the distributor arm of the manometer are now filled with nitrogen at the pressure fixed in the compensator for the analysis. This step naturally precedes the introduction of the sample and the actual analysis.

5. To measure a gas volume.—Before measurement of any volume, gas within the burette must be adjusted to the pressure fixed in compensator at beginning of analysis.

To adjust pressure in B against that in C, proceed as follows: If the pressure in B is entirely unknown, adjust to approximately atmospheric (see section 3) before opening B to M. If gas has just been returned from a pipette, it is safe to connect M to B without this adjustment.

Except when distributor to the left of 4 is already balanced, 4 must be turned ⊤, so that distributor and burette pressures are simultaneously balanced against reference pressure in C.

With 2 opened to 4, 4 turned ⊤, and 1 closed, place L_1 on a ring just above the level of the mercury in B. Open 1 slowly until mercury in compensator arm of M is within 2 to 3 mm of the platinum contact point. Then turn 1 to constriction. The mercury flows very slowly upward toward contact, and at the instant light flashes, close 1. Always make the adjustment with mercury rising toward contact—never the reverse. The gas volume is read with diffused light back of burette, and a shadow thrown upon the mercury surface in such a manner that reflections are removed.

6. To transfer gas to a pipette.—Be sure gas is displaced from M (see section 3). This leaves gas in B under reduced pressure. Open 1 until burette reading is approximately equal to or very slightly more than it was before gas was displaced from M. Close 1. Turn tee cocks of distributor so that cock above pipette into which gas is to be passed is turned and all cocks to right of this are turned ⊥. Then open cock of pipette. Open 1 to control rate of flow of gas into pipette.

7. To conduct an absorption in the plain bubbling pipette.—Consult section 6.

When adjustment is completed for delivery of gas to pipette, first open cock of pipette to normal position for withdrawal of gas, with bores in the position ∧ This drains reagent from the short capillary (gas exit). When reagent has drained, turn pipette cock to position ∨ for normal introduction of gas. Open 1 to control rate of passage of gas from B through reagent in P. Passage requires 30 to 45 seconds.

When gas has passed into P, turn cock 1 to constriction, turn pipette cock to ∧, and lower L_1 to R_1. If reagent does not rise in gas inlet capillary, open 1 and withdraw gas to B. If reagent rises in gas inlet capillary, the pipette cock has not been turned ∧, or the bore over the gas outlet is plugged with lubricant. The controlled flow through constriction of 1 affords opportunity to correct this before reagent is drawn into distributor, thus avoiding one of the major tragedies of gas analysis.

Gas is withdrawn until reagent is within about 1 cm of dome of pipette. 1 is then closed, L_1 placed on R_4, pipette cock turned ∧, and 1 again opened for second passage.

The number of passages required for complete absorption depends upon reagent and gas. Check completeness of absorption by measuring contraction and then conducting a second absorption to determine if there is further observable contraction. Experience will establish proper number of passages for each gas. 3 passages usually suffice. If many more are required, use distributor pipette (P_{3-4}).

When gas is finally returned from P to B for measurement of contraction, adjust reagent in P to etched marks on stem below pipette cock by slowly closing 1 as reagent approaches dome of P. When reagent reaches capillaries, turn 1 to constriction for final adjustment. (This permits accuracy and eliminates danger of drawing reagent into distributor.) Close 1 and pipette cock.

Allow gas to stand in B for 2 minutes to insure saturation. Then turn 4 to ⊤. Adjust pressure and determine volume (See section 5).

8. To conduct an absorption in the distributor pipette (for difficult absorptions).—Consult section 7.

The only difference in technique is in final return of gas to B. When reagent has reached the etched mark on gas exit capillary (cock 1 being turned to constriction at this moment), turn the pipette cock to ∨ This places burette suction on gas inlet alone. The reagent within this capillary, which has lagged behind because of resistance to flow through the platinum disk, is thus drawn to etched mark on capillary gas inlet. The rate of flow is easily controlled. Pipette cock is closed when reagent reaches etched mark. 1 is then closed.

9. To conduct a combustion.—Store sample left after absorption analysis over KOH in P_2, leaving M filled with gas and

balanced, 4 being turned ⊥. Draw O_2 into B and measure its volume with 4 turned ⊥. The volume of O_2 must be in excess of that required for combustion. The volume of CO_2 produced on burning, plus volume of excess O_2, plus N_2 in the sample, should not exceed 100 ml, after contraction on burning is subtracted. Experience will establish proper volumes of sample and oxygen to be taken for each kind of gas analyzed.

Transfer oxygen to combustion pipette, with all intermediate tee cocks of distributor, including 4, turned ⊥. With L_3 adjust pressure in combustion pipette (P_3) to atmospheric. Close 10. Turn 6 ⊢ and return gas sample to B. Adjust pressure in B to that of C. Turn 6 ⊥ and 4 ⊢. Displace gas from M. Close 2 and readjust pressure in B to atmospheric. Turn 4 ⊥. Swing triplex glass explosion shield in front of P_3. Turn on current so that combustion spiral warms slowly and drives off any adhering particles of mercury. Then adjust rheostat until spiral glows a cherry red. Open 2 and *very slowly* open 1 until gas from B passes at a *slow* rate (about 20 ml/min.) into P_3. The spiral will glow white when combustion starts. Control rheostat to prevent fusion of spiral. Combustion should be quiet and smooth, and should never occur in a series of explosive jerks. The latter will happen if pressures in P_3 and B are *unequal at the start of the combustion*, or if 1 is opened too fully at first. When all gas has passed from B to P_3, close 1, lower L_4 to R_3, and return gas slowly to B. Double the rate of flow if desired. Pass into P_3 three more times. (Gases containing large amounts of heavier hydrocarbons require more.) On fourth return passage, check mercury in P_3 about 4 or 5 cm below spiral. Turn off current and allow P_3 to cool 5 minutes. Return gas to B. Allow 2 minutes for temperature equilibrium. Stir water bath with a stream of air bubbles.

Measure the contraction upon burning. Then determine the carbon dioxide produced (by absorption in KOH) and the residual oxygen (by absorption in pyro). Measure the residue as nitrogen. This is to be corrected for unburned gas from the vertical leads of the distributor.

Condensed Analytical Procedure for a Fuel Gas

1. Fill distributor and distributor arm of manometer with N_2 at the fixed compensator pressure.
2. Transfer sample to burette, balance the pressure against the compensator, and determine the volume.
3. Absorb the CO_2 by three passages into KOH in P_2 and measure the residual gas.
4. Absorb the "illuminants" in fuming H_2SO_4 as follows: 3 passages into $P_2 \rightarrow$1 passage into $P_3 \rightarrow$1 passage into P_2 3 passages into P_2. On the final passage into P_2, store the gas therein until the burette is washed out with distilled water. Return the gas to B and measure.
5. Absorb the O_2 in alkaline pyrogallol solution by three passages into P_4. Measure residual volume.
6. Store the gas in P_2.
7. Take O_2 of known purity into B, measure and transfer to P_3.
8. Transfer the gas sample to B and thence to P_3 for combustion.
9. Return the residual gas to B and measure the contraction after combustion.
10. Determine the CO_2 produced by the combustion as follows: 3 passages into $P_3 \rightarrow$1 passage into $P_3 \rightarrow$2 passages into P_2. If the gas volumes are small, the above should include in addition: 1 passage into $P_3 \rightarrow$1 passage into P_2.
11. Determine the residual oxygen as follows: 3 passages into $P_4 \rightarrow$1 passage into $P_3 \rightarrow$1 passage into $P_3 \rightarrow$2 passages into P_2.

If the amount of residual gas is small, a measured volume of air may be added just before step 9 or 10. This furnishes a sufficient volume of diluting gas to sweep the reactive portions from the capillaries.

The results of the combustion analysis are computed as H_2, CO and CH_4[15] according to the equations:

$$H_2 = TC - O_2$$
$$CO = 1/3\ (4CO_2 + TC - 3O_2)$$
$$CH_4 = O_2 - 1/3\ (CO_2 + TC)$$

where TC = the total contraction observed after combustion
O_2 = the oxygen consumed during combustion
CO_2 = the carbon dioxide produced by combustion

A correction must be made for the amount of gas confined below cocks 5, 6 and 7 which was not burned. This portion of gas can of course be burned at the termination of the above procedure, and the second analysis added to the first. Much time is lost by this method, and the preferable procedure is to use the calibrated distributor system and simple arithmetic.

The calculation is illustrated by an actual analysis.

The factors known in advance are:

(1) *Calibration of the distributor system:*

Entire volume = 3.65 ml. This includes:

(a) Horizontal capillary from cock 2 to cock 7.

(b) Vertical capillaries from cocks 5, 6, 7 to etched marks on P_2, P_3, and P_4.

(c) The arm of manometer connected to 4, when manometer is balanced.

Volume of vertical capillaries, i.e., (b) as above = 1.2 ml.

(2) Oxygen used for combustion contained 0.68% nitrogen.

(3) Air used contained 79.05% nitrogen.

The analysis as observed was as follows:

Procedure
P = number of pipette into which gas is passed
n = number of passages into P

P	n	P	n	P	n	P	n	P	n	Composition		Burette readings (ml)
										Sample for analysis	S_1	66.20
2	3	..	..	..	..	..	..	..	..	After KOH	$-CO_2$	64.33
1	4	2	1	1	2	2	2	..	..	After H_2SO_4·SO_3	—Ill.	57.25
3	3									After alkaline pyrogallol	$-O_2$	56.85
										Oxygen taken for combustion	$+O_2$	55.78
										Residue after combustion	—TC	48.81
2	3	4	1	2	1	4	1	2	2	CO_2 produced on combustion	$-CO_2$	19.90
										Air added		69.42
3	4	4	1	2	1	3	2	..	..	Oxygen removed	$-O_2$	60.40

Calculations.

(1) *Carbon dioxide*

$$\frac{100\ (66.20 - 64.33)}{66.20} = 2.82\%$$

(2) *Illuminants*

$$\frac{100\ (64.33 - 57.25)}{66.20} = 10.69\%$$

(3) *Oxygen*

$$\frac{100\ (57.25 - 56.85)}{66.20} = 0.60\%$$

(4) *The sample used for combustion*

Nitrogen in distributor and manometer at beginning of analysis	3.65	ml
Gas in burette after the absorption analysis	56.85	
Total	60.50	ml
Gas in vertical capillaries not reacting during combustion	1.2	lm

Amount of sample burned =

$$56.85 - \frac{56.85}{60.50}\ 1.2 = 55.72 \text{ ml}$$

(5) *Volume of sample (=S_2) to be used to compute percentage of H_2, CO and CH_4*

Since 56.85 ml should have been burned from the original sample of 66.20, and 55.72 ml was burned,

$$S_2 = \frac{(66.20)\ (55.72)}{56.85} = 64.89 \text{ ml}$$

(6) *The total contraction (TC)*

$(56.85 + 55.78) - 48.81 = 63.82$

(7) *CO_2 Produced (CO_2)*

$48.81 - 19.90 = 28.91$

(8) *Oxygen consumed (O_2)*

From cylinder = (55.78) (.9932) = 55.40 ml
From air = (69.42) (.2095) = 14.54
Excess oxygen after combustion = (19.90 + 69.42) — (60.40 + 14.54) = 14.38 ml

Oxygen consumed = 55.40 — 14.38 = 41.02 ml

[15] *It is, of course, understood that the percentages so computed do not represent the actual amounts of these constituents, if there are other hydrocarbon gases present. Thus one volume of ethane plus one volume of hydrogen so computed would appear as two volumes of methane. Similarly 1 vol. C_2H_2 + 2 vol. H_2 would appear as 3 vol. CH_4; and 1 vol. C_4H_{10} + 3 vol. H_2 would appear as 4 vol. CH_4. The error in computing the heating value will be about 1 Btu/1% C_2H_2 present. Nevertheless, if the information derived by this simple and quick method is insufficient, the application of a more complicated method of absorption and combustion will scarcely afford material aid, and may lead to discrepancies fully as confusing. The other alternative is a separation by low temperature fractional distillation, which is quite another story. This method has been described by the author in B. S. Journal of Research 2, 1145; 1929, Research Paper No. 75.*

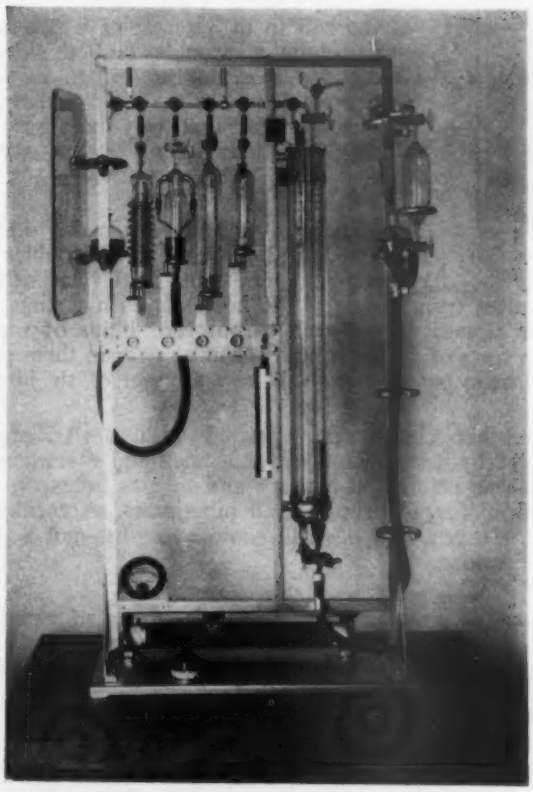


Fig. 9. Laboratory model

(9) *Hydrogen*

$$\frac{100\ [68.32 - 41.02]}{64.89} = 35.15\%$$

(10) *Carbon Monoxide*

$$\frac{100\ [1/3\ \{(4)\ (28.91) + 63.82 - 3\ (41.02)\}]}{64.89} = 28.98\%$$

(11) *Methane*

$$\frac{100\ [41.02 - 1/3\ (28.91 + 63.82)]}{64.89} = 15.59\%$$

(12) *Nitrogen*

The nitrogen added during analysis:

With oxygen	0.38 ml
With air	54.88 ml
Total	55.26 ml

The amount of sample not burned and measured as N_2 at the end of the analysis is 56.85 — 55.72 = 1.13 ml (see 5). The amount of N_2 present in the original sample which is included in this 1.13 ml is not significant in the present instance. The residual N_2 therefore is

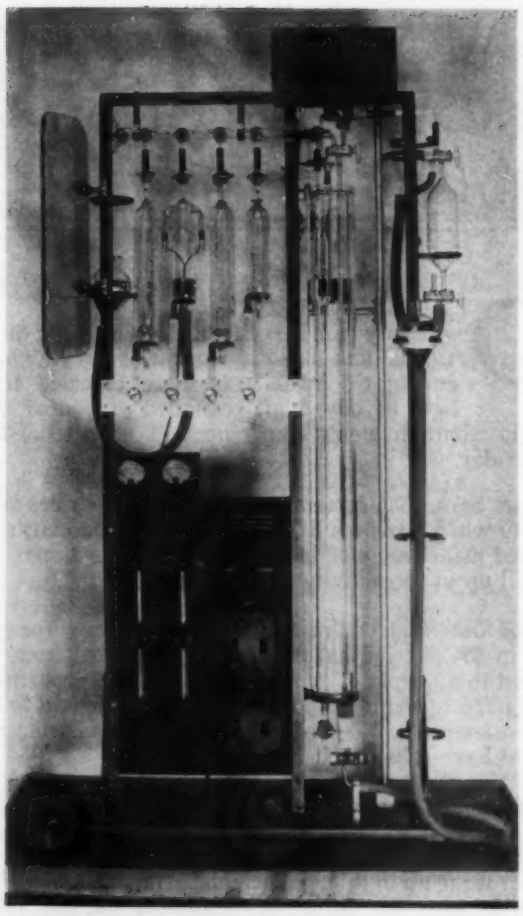


Fig. 10. Special model

$$60.40 - (55.26 + 1.13) = 4.01 \text{ ml}$$

$$\frac{100\ (4.01)}{66.20} = 6.29\%$$

The analysis so computed totals 100.09%. The analyst arrived at approximately 0.1% from the starting point. It is reported to the nearest 0.1% as follows:

CO_2	2.8%
Ill.	10.7
O_2	0.6
H_2	35.2
CO	29.0
CH_4	15.6
N_2	6.3
	100.2%

Single Meter Plan

AN activity of ours that is doing considerable to assist landlords to retain tenants is the so-called single meter plan. This is not to be confused with any sub-metering activity. A single meter is installed in a building and all of the gas consumed is registered through it and no separate record is kept or charge made to the tenants for gas service as such. In other words, we sell the idea to the landlord to include gas for refrigeration and cooking in with the rent and supply a service to his tenants that is a step nearer to complete hotel service. There is no applying for gas service on the part of the tenant, no meter reading, no bill rendering or collection made from him. The tenant has been relieved of all this, but in turn the landlord has included the cost of this service in the rent the same as he does with the hot water supply or the elevator service. This change—from separate meters for each tenant—to a single meter—can be made easily in most buildings without inconveniencing the tenants. It is working successfully, and is securing and holding the tenants for the landlords.—*A. J. Peters, Consolidated Gas Company of New York.*

DEAR SAM:

Every time I lift up a flat rock in th' woods and see th' ensuin' scurryin' about among th' inhabitants there revealed to th' light of day, I git reminded of one of these gas distribution men's conf'rences like I attended th' other day.

For, Sam, that same runnin' around in circles that's shown when a rock is lifted or a distribution conf'rence opened makes me wonder if they ain't some aimlessness mixed up in the activity in both places.

And now that you're swappin' your efforts for your pay in th' distribution end of th' game jest now, I'm moved to a couple of remarks or so in that department. And I freely admit I ain't a' engineer, havin' had to rely on hoss-sense a heap of places where a smarter man would have substituted his eddycation.

But, gittin' serious, th' hopeful thing to me about it is that they *is* so much activity. Of course, some of th' trouble is that they aint nothin' makes a big gas stockholder wake up in th' night screamin' that th' poor-house is gittin' him like havin' "Unaccounted for gas losses" mixed up in his quarterly reports and his nightmares. And when stockholders gits to screamin' th' operatin' boys jest naturally gits th' reaction—which is a nice way of saying ketches hell!

So everybody begins bustin' loose with a' idea under th' stimylus, and rushin' off to a meetin' somewhere to read a 20-page paper, 19 pages of which is devoted to tellin' how *they* have solved th' problem; and the last one devoted to explainin' that they aint sure they've solved it yet either. Only, everybody's asleep after page ten, anyhow, and it don't matter.

Pipe-corrosion gets 'em up in the air, and joint-leakage keeps 'em there. Steel pipe manyfacturers pace th' floor tryin' to decide whether to kill or cooperate with th' makers of protective pipe-coatings that's beating loud drums in th' street outside; every boost for th' coating soundin' exactly like a knock for steel.

Cast iron pipe makers, busy tryin' to live down th' kick in th' pants they give gas-pipe buyers years back when pig-iron with a hole in it, and tonnage the pipe maker's dream, dribble at the mouth around th' edges of the groups, and see a chance to sell in volume if half they hear is true.

Everybody's got a pet joint, and th' din is deafenin', 'til it drowns out the low steady pessimistic chirpin' of some embittered gas engineer in the corner that aint nothin' any good—includin' daylight savin' and th' Australian ballot—and indicatin' that he is goin' off in the garden and eat worms.

Somebody else hires a brass band and parades the hall in th' interest of a two-main system as endin' all troubles on both sides of the street. While another brings in, in a cage with padded bars, the big-city distribution man that got that way because they was too dang many mains in the' streets now.

Advocates of puttin' all mains in th' parkways and thereby endin' all troubles but hay-fever and taxes, gits in th' way of ambulances tryin' to git to the hospitals with victims run over already in the rush to put four kinds of mains, nine sorts of conduits, and a trunk sewer in them same parkways before somebody else thought of th' idee.

Another chap rushes around with a' Arithmetic, provin' by it that short-haired women and short lengths pipe was ruinin' th' country and th' gas industry, and hollerin' for abolishun of all pipe-joints. Accordin' to him, Heaven is piped with endless lengths—not a joint in a carload.

At hearin' which, three manyfacturers of couplin's and two bolt-makers creeps weepin' from th' hall and jumps into th' adjacent river, in order to go to th' other place, where they can still do bus'ness with th' gas comp'ny.

But it aint *all* bedlam, Sam. Underneath, there's a heap of cold common sense at work. Includin' recognishun of th' sound scientific principle that corn-plasters can't cure crossed-eyes, and that takin' sulphur an' molasses internally has practically no effect on fallen arches or a broken leg. Different causes, troubles, and localities still calls for different remedies. One man's panacea can still be another man's pain. And one of these days one of these brainy boys with his sleeves rolled up is goin' to shoot out of th' ruckus with th' answers. One, say, for th' lad whose soil is a mixture of sulphuric acid and quick-lime, so far as its pipe-eatin' abilities is concerned. Another for th' pipe-joint that's faced with holdin' th' gas, yet resistin' expansion, contraction, traffic poundin's, ground movement, and argument. And still another for how to squeeze in another main on State street, Chicago, without th' use of a shoe-horn. It'll be not *the* answer, but the *answers*.

And when that's done—as it will be before they quit diggin' at it—all this present scurryin' around will be justified, and th' funny way they looked to a' old fossil like me while they were doin' it, more or less forgot about.

And I'm lookin' for you up front with one of th' remedies for your comp'ny, Sam. For, after all, like charity, a sound solution for your own troubles ought to begin at home. Leavin' me.

Yours for more research and less leakage.

Monoxide Mike

AMERICAN GAS MERCHANDISING ALMANACK

June

JUNE is a happy month, the month of pearl and the wild rose, the month when dad gets a bit of attention and a big opportunity to shell out for the bride and the sweet girl graduate. It is the time when out-door sports come in for a big swing; fishing, tennis and motor trips over the week-end.

Window displays may be built to feature the advantages of food preservation to the bride, by tieing—in the silent gas refrigerator with wedding scenes, hearts, the bride, the new home, orange blossoms and wedding bells; or father may come into the picture, or the graduate, with school colors, pennants, etc.

It is said that 1,250,000 folks marry during each year in the United States and that the greater per cent of the marriages occur during the month of June. This affords the smart salesman a wonderful opportunity to sell the new home managers gas refrigeration, as well as ranges, automatic hot water service, laundry equipment and incinerators. The time to get folks to spend is when they are buying, and oh what an opportunity exists when new homes are being outfitted! June should be an ideal month for the sale of all gas appliances and especially so for gas refrigeration.

Elsewhere in this issue of the American Gas Journal will be found ideas that will aid you in doing a bang-up job of selling during the month of June. Look for them.

1—Mon.	Hold morning meeting of 15 minutes to see that the stage is all set for gas refrigerator sale. Inspect boxes on sales floors.
2—Tues.	Chalk-up results of first day's sales. Talk to salesmen individually. Look over proof of ad. to be run Wednesday.
3—Wed.	Paste up copy of advertisement in sales room; ask all salesmen to tell you what advertisement featured. Hobson sank Merrimac, 1898.
4—Thurs.	Check-up on telephone calls. George III, King of England, born, 1738.
5—Fri.	Have Home Service Department serve ices to customers; distribute ice-box recipes.
6—Sat.	Change window display tonight. Change soiled price tickets.
.7—Sun.	Resolution of Independence presented to 2nd Continental Congress, 1776.
8—Mon.	Conduct meeting 15 minutes in morning. Get advertisements ready for week.
9—Tues.	Run large advertisement; hold demonstration on sales floor. John Howard Payne, author "Home Sweet Home," born, 1791.
10—Wed.	Take trip about town to ascertain what is being done in home and apartment building.
11—Thurs.	Jeanette Rankin, congresswoman born, 1880.
12—Fri.	Run big advertisement. Have home service department demonstrate that gas refrigeration permits home manager to properly preserve fish and fowl until cooking time.
13—Sat.	See that everything is in readiness to change window display this evening. General Pershing and staff arrived in Paris, 1917.
14—Sun.	Flag Day.
15—Mon.	Check-up with manufacturer; see if there are any further sales helps to come forth.
16—Tues.	Run big ad. Paste-up advertisement in sales room. Battle of Petersburg, Va., 1864.
17—Wed.	Have salesmen make extra call on apartment house owners and builders. Battle of Bunker Hill, 1775.
18—Thurs.	Check-up on employee users.
19—Fri.	Father's Day—arrange to interview the head of the family in the evening, by appointment arranged by the home manager and with her consent.
20—Sat.	Where special offer is being made arrange to bring it to the attention of the prospective purchaser by "Only 10 Days Left" advertisement in Sunday newspaper.
21—Sun.	Plan ad to impress customer that time plays a big part in your special plan and that he must act immediately, lay this idea out with the view of running an ad. on Wednesday.
22—Mon.	Hold sales meeting; go over all details.
23—Tues.	Penn's treaty with Indians, 1693
24—Wed.	Have home service department demonstrate special dishes starting today and continuing throughout week.
25—Thurs.	Hold 15 minute meeting to discuss ways to close-up on prospect list. Custer Massacre, 1876.
26—Fri.	Lucky Friday; urge men to call on every prospect.
27—Sat.	Go over all that has been done up to now. Check over final newspaper advertisement and employees activities; arrange for final demonstrations by Home Service department.
28—Sun.	Make mental survey of what is to be done after Refrigerator activity has ended Tuesday.
29—Mon.	Final meeting to go-over "Clean-up" activities today and tomorrow. Conduct store demonstration. Check-up to see that all prospects have been called upon.
30—Tues.	Last day of activity, clean-up and sign-up day.

Summer Sale of Silence—Naturally, The Gas Refrigerator

IN building a plan to induce people to purchase gas refrigeration the following method of procedure has been found very profitable: First, layout a foundation thus; 1—A complete plan for the activity, 2—Educational work to be undertaken and accomplished, and 3—The execution of the plan. These are the cardinal points, the places to start from, and the success or failure of the whole plan depends entirely upon the thoroughness with which the details radiating from these points are worked out.

Plan of Activity

1—Duration and dates. Duration—long enough to enable the sales force and the organization to find their stride. Not too long; long drawn-out activities are tiresome and frequently lose so much momentum that the sale is a failure, regardless of how well it has been planned or how well it got off at the start. Dates should be set (now, for next month) long enough in advance to permit all preparatory work to be accomplished.

2—Merchandise to be sold. List model by model and play-up any particular model, one that analysis shows fits a general need.

3—Prices and terms. These should be established on all models and listed for quick reference. Down payments and monthly payments, time price and cash price should also be listed. All prices should include delivery and connection in the home of the customer.

4—Advertising. Work out a schedule of all advertising, show proofs and samples of all material to be used with dates of release or publication.

5—Allowance and premiums. If used, these should be listed. Make it plain that such allowance or premiums are offered *for a limited time only* and that they will positively be withdrawn at the end of the activity. Extended offers lead customers to believe you have added a lot of extras in your mark-up and cause them to expect concessions every time they make a purchase at your store.

Ray Martin, display manager of the Consolidated Gas Company used this very effective window display advertisement to bring out the fact that gas refrigeration is inexpensive.

"The Old Order Changeth,
yielding place to new"
ELECTROLUX
THE Gas REFRIGERATOR
On Display at These Stores and Gas Companies' Offices
CONSOLIDATED GAS COMPANY
KINGS COUNTY LIGHTING CO.
QUEENSBORO BOROUGH GAS CO.
NEW YORK & RICHMOND GAS COMPANY
THE RICHMOND GAS & ELECTRIC CO.
EAST RIVER GAS CO.
THE BROOKLYN UNION GAS CO.
NEW AMSTERDAM GAS CO.
NEW YORK & QUEENS GAS CO.
CENTRAL UNION GAS CO.
NORTHERN UNION GAS CO.
PUBLIC SERVICE ELECTRIC & GAS COMPANY
STANDARD GAS LIGHT CO.
WESTCHESTER LIGHTING CO.
ABRAHAM & STRAUS
FREDERICK LOESER & CO., Inc.

A very effective way of appealing to the desire for the modern. A newspaper advertisement used by the Consolidated Gas Company of New York and affiliated companies.

6—Quotas. Establish a reasonable quota for the period of the activity and break it down to teams or individual salesmen. Do not give any team or salesman a quota that you do not expect can be met.

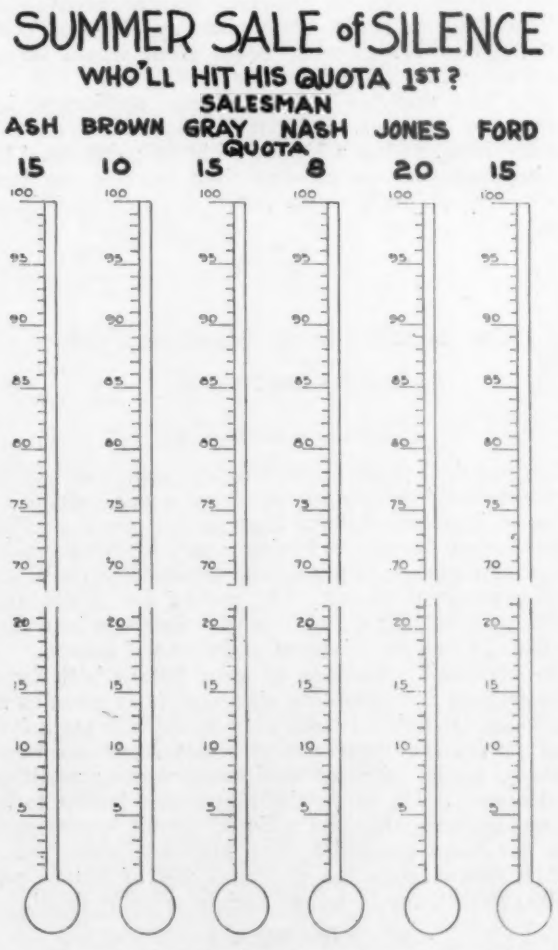
7—Employee co-operation. Lay out a plan whereby you can secure the co-operation of all employees, pay them a definite amount, say $5.00 per unit for every sale made from a lead turned in by them. Make it plain that a lead is the name and address of someone who has not been talked to by a regular salesman during a period of thirty days prior to the opening of the drive, and one who the employee feels reasonably sure is interested in the purchase of a refrigerator because he has talked to him. Have a special employee prospect card made up and insist that all prospects be turned in to the sales manager by the employee, in person, after dating and setting down the time that the prospect card was turned in. Further, it should be understood that no name will be considered that the sales department is actually calling upon with the view of selling a gas refrigerator.

8—Stock. Order for ample stock should be placed in advance of the opening of the sale. It is particularly important to have a representative store display and

enough merchandise to take care of immediate orders. A customer may look at, and talk about gas refrigerators for two years and not buy, yet, when he makes a down payment and signs the dotted line, he wants his refrigerator at once.

Educational Work

While we refer to this phase of the undertaking as "educational" it might also be thought of as something else; for instance, a rally or a get together activity. This part of the plan calls for a meeting of salesmen and all others interested (the aid of every employee should be solicited in an activity of this nature) at which the sales manager, the manager and a representative of the manufacturer should go over, in turn, the merchandise, the advertising, the offer to be made the customer, the desirability of the merchandise, the various appeals that may be employed to arouse interest, the models, the prices, the down payments, the monthly payments, and the offer to employee users (if this is to be part of the plan).



Thermometer Chart to show salesman's Records

Further, it should be brought out that the company is anxious to have the sale be a successful one for the reason that they are desirous of building up the domestic gas load and too, for the reason that it is very desirous at this time to equip the American home with more and better gas appliances. The sales manager should show the quotas set and explain what promotion work had been and would be done to help each salesman or team to make their quotas. He might also point out the advantages of gas refrigeration over other types, show how proper refrigeration saves foods, etc., etc.

Where direct mail is to be part of the promotion plan the work of listing a picked list of prospects to receive the mailings should all be worked out in advance of any other advertising, and cards for the salesmen's use should be made up listing the prospects and dates of mailings. These cards should be handled by the sales-manager who, in turning them over to the salesman, should demand a report back in a stated time.

Newspaper and other forms of advertising should all be laid-out as far in advance of the opening of the sale as is possible and proofs of the ads and samples of the other advertising should be at hand to use in connection with morning or evening meetings.

Window and store displays should also all be planned well in advance of the opening of the activity. A window display or displays should be "in" and the floor displays all set up on the morning the drive opens.

Plans for salesmen's calls should be worked out by sections, streets or blocks. A plan for developing prospects and arranging for calls for salesmen, via the telephone, should be scheduled and delegated to a young lady who has been properly schooled in this manner of customer approach.

Plans for store and window demonstrations to be held at least twice each week during the activity should be worked out in advance and advertised in the Friday Food Sections of the newspapers.

All other forms of advertising, posters, store and window cards, truck banners, novelties, etc., etc., should be ordered along with any special forms that may have to be printed or imprinted, such as special recipe cards and books. Detail by detail these "things to do" should be set down on a schedule to be used by the sales manager, in order that he may see that everything moves as scheduled from day to day during the activity.

Other Items That May Help

A—In opening a sale of this kind it is an excellent stimulant to have the manager of the organization manifest an interest in the activity. A personal letter sent by this executive to all employees builds up an interest in a big way. This letter should be written somewhat along the following lines:

"Dear Co-Worker:

On June first we open our "Summer Sale of Silence"—an activity to sell gas refrigerators, and build up our sales per meter.

We naturally want to make this a most successful undertaking. We want to set-up something in the way of a record that we all may be justly proud of, something for other gas companies to shoot at—and we can do it with your help.

Your job as an individual will not be a hard one. All we ask of you is that during the next thirty days you talk about gas refrigeration, ask your friends and neighbors if they wouldn't like to own a silent gas refrigerator. Mr. ———— will acquaint you with the refrigerator we have to offer and furnish you with descriptive matter and prices and terms and cards to use to supply the names and addresses of interested friends. Ask him for the folder today and let him explain the simplicity of gas refrigeration to you in order that you may help us put this sale over. I am depending upon you and will be mighty happy to see your prize check come over my desk. I am starting today to get five prospects myself.

Sincerely yours,

General Manager.

P. S.—See Bulletin Board for Prize Offer.

B—Prizes for salesmen are often used. Both cash and merchandise have proven popular. Where merchandise has been used the catalog is sent to the man's home with the idea that the feminine members of his family will become interested in the prizes and thus aid him in securing new prospects.

C—Contests for salesmen are frequently staged. Among those that have proven successful are Cross Country Races, via blimp, ship, and auto. The Bean and Turkey Dinner affords a great kick to some organizations. The Stud Poker Contest has proven popular in the past, along with the Fill the Holder Contest, the Pot of Gold Contest and a number of others. Prizes are used in connection with all of these contests. (See back issues of this magazine for details).

D—Charts of various descriptions are used to good advantage during these special activities. In an activity of this kind the thermometer chart (see illustration) is very popular. This chart enables the salesmanager to keep sales and quotas before his men at all times, is easily plotted and understood and adds a bit of competition among the men.

E—Using the user is another idea that is gaining in prominence and popularity. This plan calls for a canvass of all users for the purpose of securing the names and addresses of people who have seen the gas refrigerator and who have actually expressed a desire to own one. A list of users is made out in card form and turned over to the salesmanager, who in turn hands the cards and a small advertising novelty (a water bottle, a box of recipe cards or a cook book) over to the salesman with instruction to call on the user and present the gift and secure the name or names of friends who have expressed a desire to own a gas refrigerator. All cards are turned back to the salesmanager with a full report by the salesman together with the names of prospects secured. Prospects, naturally, are then turned over to the salesman in whose territory they happen to live with instructions to call, etc. This plan is most effective when carried out in detail. The call, by the way, on the user is the first call to be made by the salesman on the day the card is turned over to him.

Bluefield Gas Co. Doubles Output of Gas Refrigerators In 1930

"MECHANICAL refrigeration is increasing by leaps and bounds," said S. B. Thompson, advertising manager of the Bluefield Gas and Power Co., Bluefield, W. Va. "In 1930 we increased our 1929 installations by 100%, and 1931 has started equally as good. This was due in part to the intensive campaign we carried out to educate the people as to the value of gas refrigeration. This campaign lasted three months, and during this time we made use of newspaper advertising, window display and direct mail. I think the best results were gained through direct mail. In this section of the campaign every letter was individual, and we only went after what we called 'hot prospects'—people who had given us some definite reason for believing they were in the market for a gas refrigerator.

"Before starting our campaign we worked up a good list of prospects, some of which were gained through tips from our sales force as to people who had looked at refrigerators in the salesroom, and others through systematic canvassing on the part of our outside salesmen.

"We hold only one special refrigerator sale a year, and are therefore able to offer good bargains. In our last campaign we offered to accept the old refrigerator as part payment on the new. Each refrigerator was examined by one of our experts and taken at its value to us. There is still a large demand for ice refrigerators here, so after we reconditioned the old ice box, and placed it in the re-built refrigerator section we had no trouble at all in selling it for cash at a small profit. During our sale we offered the new gas refrigerator on deferred payments if desired—10% down, and 18 months in which to pay the balance.

"These terms, and the fact that we traded in old refrigerators, were stated in our newspaper advertising, which included not only the local papers, but those of a number of country towns adjoining. During this time we also had a window devoted to a showing of these refrigerators. In the rear was a cutout of a big polar bear on a cake of ice, and a sign "Keep Foods Cool the Gas Way," while down front was a larger card stating the terms of the sale.

"The fact that we service all our appliances, including refrigerators, and put no time limit on this free servicing, makes a big hit with the public, and by keeping our patrons satisfied they become our best advertisers, and help us to put over many additional sales."

Use of Butane in Meeting Peak Load Conditions

(*Continued from page 53*)

The practical problem of meeting peak load conditions resolves into one of supplying a gas capable of giving an appliance thermal input of not less than 90% of the normal input, and having a rate of flame propagation high enough to permit the desired input without blowing away of flames. The use of the tables and figures permits easy calculation of volumetric increases possible for various mixtures of gases and butane.

The economic advantage of using butane both from an investment and operating viewpoint is so great as to be obvious. Individual cases vary so much in manufactured gas investment costs that in order to make comparisons, details of plant equipment already available are necessary. The properties that enable butane to be transported and stored as a liquid permit low storage costs for large quantities of readily available fuel.

Table No. 4 gives the delivered cost of butane per 100,000 B.T.U. for costs and freight rates as listed.

Table No. 4

Delivered Cost of Butane per 100,000 B.T.U. (therm)

Butane F.O.B. Cost per Gallon	Freight Rate Per Gallon Group III			
	$0.010	$0.020	$0.030	$0.040
$0.0200	$0.0293	$0.0390	$0.0488	$0.0585
0.0225	0.0317	0.0415	0.0512	0.0610
0.0250	0.0342	0.0440	0.0537	0.0635
0.0275	0.0366	0.0463	0.0561	0.0658
0.0300	0.0390	0.0488	0.0585	0.0683
0.0325	0.0415	0.0512	0.0610	0.0708
0.0350	0.0440	0.0537	0.0635	0.0731
0.0375	0.0463	0.0561	0.0658	0.0756
0.0400	0.0488	0.0585	0.0683	0.0781

Important Distribution Problems Discussed at Annual Conference in Cincinnati

THE Eighth Annual Distribution Conference of American Gas Association, held at Cincinnati, April 8-10, amply attested to the value of thesse gatherings. Upwards of four hundred gas men from many sections of the country were in attendance and various problems on distribution subjects were discussed. Obviously, the matter of natural gas and its bearing on distribution procedure occupied an important place in the conference.

Pipe protection, butane-air gas systems, distribution machinery, meters, pipe joints and welding, distribution pressures and other important topics were covered by the papers presented.

The dominating thought to be gathered from this meeting would seem to be that the next five or six years will see great strides made in distribution work, and problems which at present seem obscure and difficult of solution will be mastered by research and a pooling of the best ideas from distribution engineers as a whole.

George Wehrle, Public Service Company of Colorado, Denver, discussed the change-over from manufactured to natural gas, particularly from the standpoints of:

1. Effect of natural gas upon consumption.
2. Effect of natural gas upon revenue.
3. Effect of natural gas upon unaccounted-for gas.
4. Effect of natural gas upon service.
5. Effect of natural gas upon hazard.

From his report the following tabulation is of particular interest.

Comparison Between Manufactured and Natural Gas Statistics—Denver, Colo.

	Manufactured Gas—1927	Natural Gas—1930	Increase Col. 2 over Col. 1	
Number Domestic Customers	65,302.00	61,567.00	—3,735.00 or	—5.70%
Number Housheating Customers	372.00	8,054.00	+7,682.00 or	+2,090.00%
Number Commercial Customers	5,366.00	7,312.00	—54.00 or	—1.00%
Total Domestic Rate Customers	71,040.00	74,933.00	+3,893.00 or	+5.49%
Number Industrial Customers	.....	86.00	+86.00 or	.....
Total Number Customers	71,040.00	75,019.00	+3,979.00 or	+5.60%
Sales per Domestic Customer	29.20	15.10	—14.10 or	—48.30%
Sales per Housecheating Customer	733.30	257.70	—475.60 or	—65.00%
Sales per Commercial Customer	200.00	130.82	—69.18 or	—34.50%
Average Sales per Domestic Rate Customer	45.73	49.50	+3.77 or	+8.20%
Sales per Industrial Customer	.....	15,184.70	+15,184.70 or	.....
Average Sales per Customer	45.73	66.73	+21.00 or	+46.00%
Domestic Sales—M C.F.	1,906,817.00	929,947.00	—976,870.00 or	—51.30%
Housheating Sales—M C.F.	272,645.00	2,075,521.00	+1,802,876.00 or	+660.00%
Commercial Sales—M C.F.	1,072,645.00	694,923.00	—377,722.00 or	—35.30%
Total Domestic Rate Sales—M C.F	3,252,107.00	3,700,391.00	+448,284.00 or	+13.80%
Industrial Sales—M C.F.	.....	1,305,888.00	+1,305,888.00 or	.....
Total Sales—M C.F.	3,252,107.00	5,006,279.00	+1,754,172.00 or	+54.00%
M² B.t.u. per Domestic Customer	11.68	15.10	+3.42 or	+29.30%
M² B.t.u. per Housheating Customer	293.32	257.70	—35.62 or	—12.15%
M² B.t.u. per Commercial Customer	80.00	130.82	+50.82 or	+63.70%
M² B.t.u. per Average Domestic Rate Customer	18.29	49.50	+31.21 or	+170.05%
M² B.t.u. per Industrial Customer	.....	15,184.70	+15,184.70 or	.....
M² B.t.u. per Average Customer	18.29	66.73	+48.44 or	+264.50%

Price on Arc Welding

H. C. Price, Welding Engineering Company, Bartlesville, Oklahoma, traced the development of electric welding in his paper, "Arc Welding of Steel Pipe." He noted the following conclusions:

The advantages of this type of electric welding can be expressed under three headings—quality, speed and cost. Under quality we have four points, as follows:

1. STRENGTH AND DUCTILITY OF WELD. This is proven by actual data. We have a weld whose grain structure closely approaches that of the pipe.

2. ELIMINATION OF LEAKS. The weld metal when applied is very fluid, resulting in a minimum of number pin holes. By applying the weld in two beads pin holes on the finished weld are practically eliminated. In 312 miles of line which have been tested up to this time, pin holes have been discovered in only three welds.

3. UNIFORMITY OF THE WELDING. This method has eliminated much of the human element in field welding. The weld is made more quickly; high current and heat are used, and it is practically impossible not to penetrate thoroughly or to get good fusion. The changes in the temperament and the physical condition of the operator will not readily affect the quality of the welding as has been the case heretofore. The welding is less tedious and tiring.

4. FEWER WELDERS ARE NEEDED. With the results that better and higher grade welders are obtainable. Our experience has shown that the heretofore serious trouble caused by turnover of labor has been eliminated. We had fifty welders working at various times since last July. Of these not one man quit during the operation of the jobs, four men left our employ after some of the jobs were completed, but forty-six of the men are still on our payroll.

SPEED. From the data it is evident that the speed of welding has been increased about threefold. The speed not only affects the cost of the welding alone, but also the efficiency of other operations connected with the laying of pipe lines. By the use of this method you can be assured of having the welding crews out of the way of the pipe laying crews. It is essentially a clean cut operation, and the old trouble of having everything tied up behind the welders should not occur.

COST. We do not intend to enter into any argument comparing costs of this method with other methods. The cost for different jobs, even using the same method, vary greatly, and any figures that I might furnish from one job certainly might not apply to others. This I will state, however, experience has shown that by the use of electric welding with heavily coated rod considerable saving has been made.

Use of Wedgetite Rings

"Experience of the United Gas Improvement with Wedgetite Rubber Rings," by H. W. Battin, United Gas Improvement Company, Philadelphia, showed that this company in 1930 used these rings in practically all of their properties for new main extension work as follows: 4 inch, 18 miles; 6 inch, 5 miles; 8 inch, 8 miles; 10 inch, ½ mile; 12 inch, 7 miles; 16 inch, 1 mile. These are all either low or intermediate pressure mains. The intermediate pressure mains are carrying gas at a maximum pressure of 20 lbs. per sq. in and were tested at the time of installation with a maximum of 35 lbs. per sq. in. air pressure.

Mr. Battin stated that a little trouble was experienced at the outset due to the fact that bell and spigot specifications had not been followed in some cases. However, the manufacturers were induced to alter their design so that this phase was taken care of, with satisfactory results.

"In U. G. I. properties," said Mr. Battin, the Wedgetite Rubber Rings, in most cases, have replaced the ordinary cement joint, and since a variation in joint space offered no particular difficulty in making a good cement joint we had not been so particular regarding the diameters of the spigot and the bell. However, with the use of the Wedgetite Rubber Rings we found that it was advantageous to have a more uniform joint space. A closer inspection at the foundries has resulted in the receipt of pipe having more satisfactory dimensions.

"Most of the Wedgetite joints we made have gone through more than half of a summer, and a full winter, and we have not had a single leak.

"The Wedgetite-Cement Joint exceeds the cost of the ordinary cement joint by an amount only slightly more than the cost of the Wedgetite Rubber Rings, and we consider that we are justified in spending this additional amount. We believe that the use of this joint will eliminate the expense of repairing leaky joints even when we eventually convert some of the present low pressure mains to intermediate pressures."

Studies of Soil Corrosion

"Soil Corrosion Studies of the Bureau of Standards," by K. H. Logan, Bureau of Standards, Washington, D. C., discussed the difficulty of definitely drawing conclusions at the present time regarding the effects of various soils on pipe. Mr. Logan spoke of the cooperation between the Department of Agriculture and the Cast Iron Pipe Research Association along the line of producing a map which will show roughly the distribution of corrosive soils in the United States.

"It is probable," said Mr. Logan, that it will seldom be practicable to predetermine accurately the corrosion to which a long pipe line will be subjected. Nevertheless, it is probable that even now a careful survey of a pipe line route for the purpose of determining the corrosiveness of the soils encountered is more than justified if the work is undertaken by someone familiar with soil corrosion problems.

"The thing which raises the greatest doubt as to the advisability of a soil corrosion survey is the uncertainty as to the proper method for providing against the action of the corrosive soils after they have been located.

"Such data as are available indicate that the conditions under which pipe lines are frequently laid make it very difficult if not impossible to properly apply certain types of protective coatings. There is also evidence that some protective coatings which are satisfactory under some conditions fail when exposed to others. Unfortunately the necessary requirements for pipe line protection under various soil conditions are but partially understood. The maker of coatings has no sure way of determining whether his new product will render better service and the purchaser no rapid means of determining whether a proposed product will fulfill his requirements. Most data on field performance of coatings are indefinite as to the exact performance of the material reported upon and as to the soil conditions affecting the installation. On this account data on the failure or success of a coating in one part of the country are frequently of little real help in the protection of a new line."

Economics of Butane-Air Gas Systems

"Economics of Butane-Air Gas Systems," was read by Leon J. Willien, Byllesby Engineering and Management Corporation, Chicago, and discussed the total investment requirements, total operating costs and the net earnings for serving butane-air gas to 300, 500, 750, 1000 and 1500 customers in small communities.

From certain basic data Mr. Willien derived the following two tables on the cost of operation and revenue to be derived from butane-air gas systems of the size indicated above. In most instances this basic data was obtained from such systems already in operation; however, where any necessary data were erratic recourse was had to data obtained from

TABLE I

Total Capital Investment

Customers Served	300	500	750	1000	1500
Intangible					
Organization	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000
Franchise	1,000	1,000	1,000	1,000	1,000
Total Intangible	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000
Tangible					
Plant Cost					
Land & Grading	$ 800	$ 800	$ 800	$ 1,200	$ 1,200
Railroad Siding	1,100	1,100	1,100	1,100	1,100
Building	3,g00	3,500	3,500	5,000	5,000
Butane Storage Tank	2,500	2,500	2,500	3,000	3,000
Gas Storage Tank	2,600	4,300	6,450	8,600	12,900
Vaporizing Equipment	660	660	660	660	660
Carbureting Equipment	1,560	1,560	1,560	3,120	3,120
Control Equipment	1,320	1,320	1,320	1,320	1,320
Compressing Equipment	1,140	1,140	1,140	2,280	2,280
Misc. Ltg., Piping, elec. and water service	3,600	3,600	3,600	5,000	5,000
Total Plant Cost	$18,780	$20,480	$ 22,630	$ 31,280	$ 35,580
Distribution System	29,100	48,500	72,750	97,000	145,500
Office furniture & fixtures	600	600	600	1,000	1,000
Working Capital	1,600	2,500	3,560	4,500	6,500
Total Tangible	$50,080	$72,080	$ 99,540	$133,780	$188,580
Total Capital Investment	$53,080	$75,080	$102,540	$136,780	$191,580

TABLE II

Operating Expenses, Revenues, and Net Returns Per Year Basis

Customers Served	300	500	750	1000	1500
Butane	$ 3,500	$ 5,835	$ 8,750	$11,670	$17,500
Power	423	705	1,060	1,410	2,120
Supt. & Labor	600	600	600	1,000	1,000
Misc. Sup. & Exp.	350	350	350	500	500
Prod. Maint.	190	315	470	630	940
Total Prod. & Maint.	$ 5,063	$ 7,805	$11,230	$15,210	$22,060
Distribution Expense	1,650	2,200	2,775	3,400	4,650
Commercial Expense	900	1,500	2,100	2,600	3,450
New Business Expense	600	950	1,350	1,700	2,325
General & Misc. Expense	1,470	2,350	3,300	4,100	5,475
Total Oper. Expense	$ 9,683	$14,805	$20,755	$27,010	$37,960
Revenues from Gas Sales	$13,200	$22,000	$33,000	$44,000	$66,000
Revenues from Merchandise Sales	600	950	1,350	1,700	2,325
Total Revenue	$13,800	$22,950	$34,350	$45,700	$68,325
Net Oper. Revenue	4,117	8,145	13,595	18,690	30,365
Taxes	$ 970	$ 1,392	$ 1,920	$ 2,585	$ 3,640
Depreciation	2,605	3,260	4,082	5,553	7,190
Total Taxes & Depr.	$ 3,575	$ 4,652	$ 6.002	$ 8,138	$10,830
Net Revenue	542	3,493	7,593	10,552	19,535
Net Revenue on Capital Investment	1.0%	4.7%	7.4%	7.7%	10.2%

manufactured gas plants of a comparable size.

Soil Stresses

"Soil stresses," said Mr. O. K. Smith, in his paper, 'A Study of the Various Kinds and Types of Underground Pipe Coatings,' "and the ability of the construction engineer to lay the pipe without injuring a coating are factors governing the physical properties of the efficient pipe coatings today. Soil stresses may be termed counter action on the part of the soil to the expansion or contraction of the pipe. Again, it may come from wet marshy soil drying out and forming deep cracks in the earth. As these cracks open up, it is possible that a thin coating would be ruptured at this point. An enamel coating, especially if reinforced by wrappers, would be less liable to rupture under these stresses. To use a pitch without a filler, it is necessary to concentrate the material to a higher melting point than if a suitable filler were used. This, of course, gives a more brittle coating and greater possibilities of cracking and spalling under soil stresses and temperature variations. With suitable fillers such as the addition of more carbon black, silica, mica, asbestos, tallow, etc., the melting point can be lower and yet have a coating which will not flow to the lower side of the pipe after installation.

"We have come to the conclusion that a wrapped pipe using one or more coats of hot application enamel and one wrapping of a suitable wrapper is the most efficient coating which can be put on. We believe also that this should be done by machine either in the field or at the pipe mills. You may say that ordinarily the costs are too great to use this type of construction. This brings out the economic side of the problem, and we also believe that the value of a pipe coating in years of service is proportional to the original expenditure, whether it be a single coat of a cold application material, or the highest quality mill wrapped pipe.

"The wrapped pipe also has it advantage in construction within the city limits. Mains are usually laid through the boulevards and it becomes necessary to tunnel under driveways and sidewalks. These may be as high as ten or twelve in each city block. Herein lies one of the worse difficulties in constructing lines of coated pipe and getting the pipe laid in the trench without injuring the coating in a great many places. When it is necessary to force the pipe through tunneled places, we are quite firmly of the opinion that a machine wrapped pipe offers the best solution of the problem, and also the most economical in the end.

"In looking at this problem from the most efficient standpoint, we believe it is going to be necessary for the manufacturers in the future to produce enamels of varying qualities, especially as to melting point to cope with the different conditions in construction."

Distribution Design

Distribution design for the cities of Los Angeles, Denver, Cincinnati and Chicago was handled in papers by Messrs. Wm. H. Henderson, C. A. Harrison, E. A. Munyan and V. F. Bittner and J. J. Novy respectively.

"It is obvious that in general no great economies can be realized immediately in changing a distribution system from one type to a more efficient type of design," said Mr. Harrison, "and in some cases such a change may result in an increased cost for the immediate future. However, all distribution systems are small before they become large, and the economy or waste due to distribution design becomes large in proportion to the increase in the size of the system. At this particular time many systems are confronted with the conversion to natural gas. As a result these systems may in two or three years take on an increase in gas loads which under normal conditions of development would only be realized in twenty years or more. The resulting economies of adopting a more efficient type of design are under these conditions realized in a very short period. It may, therefore, be particularly advantageous, as my own organization has done in many cases, to completely change the type of distribution design and operation, at the time a conversion is made to natural gas."

In part Mr. E. A. Munyan, Union Gas & Electric Company, Cincinnati, drew attention to the relationship existing between the distribution and sales departments, saying

"Just remember that gas heating for industrial use is here to stay and until some better and cheaper sources of energy than used at the present time is developed. Househeating is also here to stay, and very soon houses heated with coal, coke, oil, etc. will be obsolete and houses not heated with gas will be hard to sell and rent on account of inconvenience involved. Then will be your opportunity to do some of the things some distribution engineers have wished to do for some time in the way of improvements. It behooves us all to watch the progress of our sales departments and to design or re-design our systems, raise pressures, etc., in anticipation of increased loads and particularly the househeating load."

In describing distribution design for their particular city Messrs. Bittner and Novy, The Peoples Gas Light & Coke Company, Chicago, narrated the study their company had made to determine the proper type of system. This study began in 1906. They also told of how their company makes a pressure survey each year and how any sagging tendency in pressure is corrected. "Invariably," said Messrs. Bittner and Novy, "normal pressures are restored by the installation of a distribution feeder main, or the installation of a district regulator and transmission main, or both. When the drop in pressure is only slight, the increasing of regulator pressures, or the installation of automatic loading devices on the governors are resorted to."

As regards the kind of pipe used these gentlemen stated that cast iron bell and spigot pipe predominates. "The old bell and spigot pipe with its cast lead, cement, lead wool, and other types and combinations of joints and leak clamps, did not produce a tight distribution system, and since 1923 all new main installations have been made with cast iron mains embodying improved joints. Of late, Anthony pipe has been used extensively in the smaller sizes, while cast. iron plain end pipe with Dresser couplings has been used for the larger installations."

With reference to the coming of natural gas to Chicago they had the following to say:

"Approximately 39 years ago, natural gas was transported to the City of Chicago from the Kokomo gas fields in Indiana through 2—10" screw extra heavy wrought iron gas mains. The gas fields were gradually depleted, and became exhausted in 1917. We are now on the threshold of the second advent of natural gas, and before the expiration of another year, we hope to have a natural gas mixture available for distribution.

"The increase in the B.t.u. value resulting from the introduction of natural gas, will at first increase the capacity of our present main system. However, due to the fact that the natural gas mixture will be supplied to the system at only two points, it will follow that the gas must travel greater distances to supply the consumers. To meet this condition it is planned to raise the initial pressure of the 36" and 48" medium pressure belt line from the present pressure of 7 lb. to an ultimate maximum pressure of 25 lb. In order to prevent increased leakage from the bell and spigot joints due to the increase of pressure, it is planned to reinforce these joints with leak clamps. It is believed that the low pressure distribution system will not require much increase in main capacity for several years.

"The network of smaller medium pressure transmission mains will continue to carry the same pressure. The majority of these mains are cast iron bell and spigot pipe which cannot carry the higher pressures without leak clamping. The cost of leak clamping these mains would be excessive, and will only be resorted to in individual cases where it is cheaper to leak clamp than it is to extend a new high presure main into the district requiring reinforcing. Therefore, pound to pound regulators are to be installed at the junction of the smaller medium pressure transmission mains ,and the higher pressure 36" and 48" belt lines. Studies which have been made indicate that additional capacity

can be obtained in the distribution system more cehaply through the installation of district regulators and short extensions of transmission mains than through the installation of additional distribution feeder mains. In actual practice, we expect that a combination of both will be required."

Spindle Talks on Gas Meters

In his paper, "Effect of Dehydration and Oil Fogging on Meters," J. E. Spindle, Grand Rapids Gas Light Company, brought out the need for doing everything possible to keep the gas from affecting the meter adversely. Mr. Spindle's paper told of what his company has been doing as regards dehydration and oil fogging with the following results:

"The best evidence of the results obtained is the record of the seven year routine change meters passing through our meter repair shop. The record as shown includes the year 1927 previous to the use of dehydration and oil fogging, 1928 during which year we had nine months of water saturated gas distribution and three months with partial dehydration and some oil fogging:

Year	Meters	% O. K	% Slow	% Fast
1927	8894	47.54	31.72	15.53
1928	7502	51.22	22.59	19.80
1929	8640	52.14	21.39	21.54
1930	7967	61.37	15.75	19.17

"The last year represents a continuous practice of partial dehydration and oil fogging. The results therefore show the gradual improvement in registering accuracy of our meters. Under our seven year routine change plan all of our meters will soon have been set under these favorable conditions.

"During the past year we decided to find out if the older meters which had been in use under both conditions would reflect a condition somewhat in proportion to the time in service under old and new conditions. We selected two hundred meters which had been in service five years, three years under old conditions and two years under the new, and found their condition better than the seven year routine change average condition:

Service	Meters Tested	% O. K.	% Slow	% Fast	Avg. Net Error
5 years	200	65.6	13.5	21.0	0.80% fast

"To carry this information a little farther we selected two hundred more which had been in service four years indicating two years under each kind of service and obtained even better results:

Service	Meters Tested	% O. K.	% Slow	% Fast	Avg. Net Error
4 years	200	71.14	3.98	24.87	1.19% fast

"Then to completely satisfy our curiosity in this matter we took another group of forty-four meters that were set after the dehydration plant and fogging were in use and had been in service two years and found still further improvement:

Service	Meters Tested	% O. K.	% Slow	% Fast	Avg. Net Error
2 years	44	75.0	25.0	—	2.21 slow

"These figures substantiate our expectation that conditions would definitely improve with particular respect to the registration of our meters, and we feel sure that as our seven year routine change period reaches all meters we will then have ideal meter conditions. A fourteen year diaphragm change was inaugurated several years ago. This procedure improved conditions but we have now come to the conclusion that this diaphragm life can be extended."

Other reports and papers were read as follows:

"Report: Cast Iron Pipe Standards Committee," Walton Forstall, Philadelphia Gas Works Company; "Report: Pipe Joints Committee," H. W. Battin, United Gas Improvement Company, Philadelphia; "Report: Pipe Joint Research at A. G. A. Laboratory, K. R. Knapp, A. G. A. Laboratory; "Mechanical Joints Test in Conjunction with Cast Iron Pipe Research Ass'n," K. R. Knapp, A. G. A. Laboratory; "Movement of Pipe in Sub-Soil," Wm. H. Henderson, Los Angeles Gas & Electric Corporation; "Report: Committee on Pipe Coatings and Corrosion," J. K. Crowell, S. R. Dresser Manufacturing Company; "Report: Developments in Pipe Coatings Research," Dr. Scott Ewing, Bureau of Standards, Washington, D. C.; "Summary of Progress in Corrosion Research of the A. P. I.," Dr. Gordon Scott, Bureau of Standards, Washington, D. C.; "The Application of High and Low Pressures to Various Distribution Systems," C. S. Goldsmith, Brooklyn Union Gas Company; "Report: Meters Committee," J. E. Overbeck, Columbia Engineering and Management Corp., Columbus, Ohio; "Power Tamping Machines," W. E. Kemen, Milwaukee Gas Light Company; "Boring Machines of Special Design," A. H. Anderson, Detroit City Gas Company; "Report: Committee on Lost and Unaccounted for Gas," J. M. Pickford, Midland United Company, Chicago; "The Design and Operation of a Butane-Air Plant and Distribution System," E. L. Fischer, United Light & Power Company, Davenport, Iowa.

EQUIPMENT NEWS

New High Pressure Gas Valve for Building Services

The Kitson Company, 261 N. Broad St., Philadelphia, Pa., announce a new high pressure gas valve for house services. The valve is attached to the service pipe where it enters the cellar. The regulator to cut down the pressure is attached after the valve. The valve turns on and off easily, which protects the mercury seal in the regulator.

The valve is placed in position with the clean-out pointing downward. The threaded opening is connected to the service, the other threaded opening being on the side, so that a reducing ell can be connected, and the riser supplying the building can be placed in a vertical position.

The valve can be set either full open or all off, and is gas tight either way. There is provision in the stem for a plug or a wire and seal so that the valve cannot be tampered with after being set.

If there is any dirt or dust going into the valve, it will remain in the dust chamber, and can be cleaned out by turn-

(*Equipment news continued on page 84*)

Tycos Pilot-Operated Pressure Regulators for Efficient CONTROL on Natural Gas Lines

IN all three divisions of the Natural Gas Industry, production, transportation and distribution, the close, sensitive control of Tycos PILOT-OPERATED Pressure Regulators means efficiency and economy.

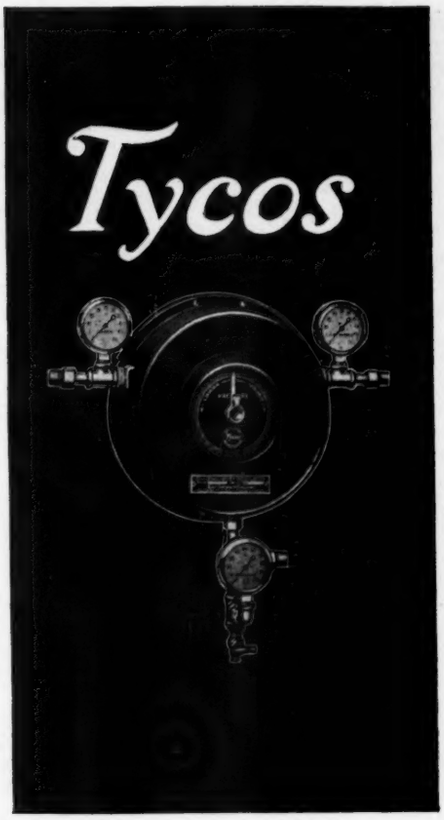
These Tycos Regulators are used with great success for back-pressure control on Natural Gas Gasoline Stills . . . . for pressure control on heating processes . . . . and for pressure control over distribution systems.

Not only is the accurate control offered by Tycos Regulators valuable in itself for safe and economical transportation and use of natural gas. It is of additional value because the smooth regulation makes possible accuracy of flow measurement, so important to both the distributor and user.

Taylor Instrument Companies

In Canada
Taylor Instrument Companies
of Canada, Ltd.
Tycos Building, Toronto

In Great Britain
Manufacturing Distributors
Short & Mason, Ltd.
London, E-17



Tycos Instruments for the Gas Industry

Anemometers
Barometers
Dipping Needles
Distillation Apparatus
Draft Gauges
Gas Main Thermometers
Gas Leak Indicators
Hydrometers
Industrial Thermometers
Pressure and Vacuum Gauges
Pressure Control
Pyrometers
Recording Thermometers
Regulators, Temperature
Regulators, Pressure
Water Line Thermometers

Write for information

Taylor Instrument Companies
95 Ames Street
Rochester, New York

Please send full information concerning Tycos Instruments for the Gas Industry to

.....

.....

.....

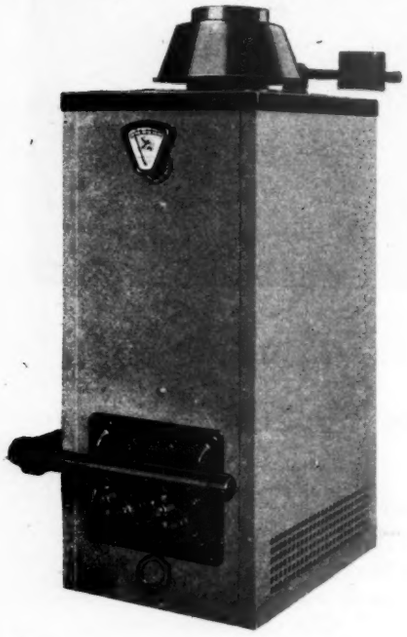
New High Pressure Gas Valve

(*Continued from page 82*)

ingoff the valve and removing the plug or seal. If it is desired to blow the service, turn the gas off, connect up dust orifice with the pump, and then turn on the valve.

New Gas Boiler for Small Homes and Shops

The American Radiator Co., 40 W. 40th St., New York City, recently issued a folder describing Ideal Arcola Gas Boilers. These boilers are particularly adapted to small homes without basements, also for shops and garages where no central heating plant has been provided. When the househeating requirements are small, it may be connected indirectly with a regular water storage tank which will furnish hot water supply for the home as well as heat. The cost of installation is small, and its operation is automatic. Copy of booklet will be mailed on request.



Gardner-Goodman Gas Main Stopper

The Safety Gas Main Stopper Co. 523 Atlantic Ave., Brooklyn, N. Y., announce the Gardner Goodman Stopper for low or intermediate pressure.

The stopper has been used very effectively on pressure up to eight pounds. It is being made in sizes for use in mains from 4 to 8 inches. It is an invention of Mr. Willis W. Gardner, District Gas Engineer of the Connecticut Light & Power Company at Meriden, Connecticut, who has had thirty years of practical experience in the gas business and who has been using his device very successfully for the last year. The patent for the stopper is now pending.

The canvas covered bag of the Goodman make, which has been standard equipment for some time is used and the invention consists of a brass cylindrical container for the bag, to be screwed into a tapped hole in the main with the minimum of danger to the operator from escaping gas. The insertion of the end of the container in the hole in the main effectually stops the flow of escaping gas.

One of the special claims made for the device is that the bag can be inserted into a live main with a minimum of danger to the workmen. The invention was developed by Mr. Gardner because of the hazard involved in inserting the old type of bag in pressure mains.

Gardner-Goodman Stopper

Roberts Junior Burner for the Small House

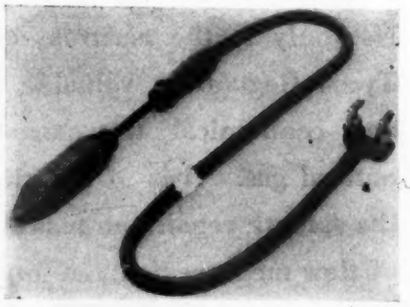
The Roberts-Gordon Appliance Corporation, Curtiss Bldg., Buffalo, N. Y., announce the "Roberts Junior" conversion burner. It has the same automatic features of the larger types of Roberts burners and was designed to meet the demands of the modest income house.

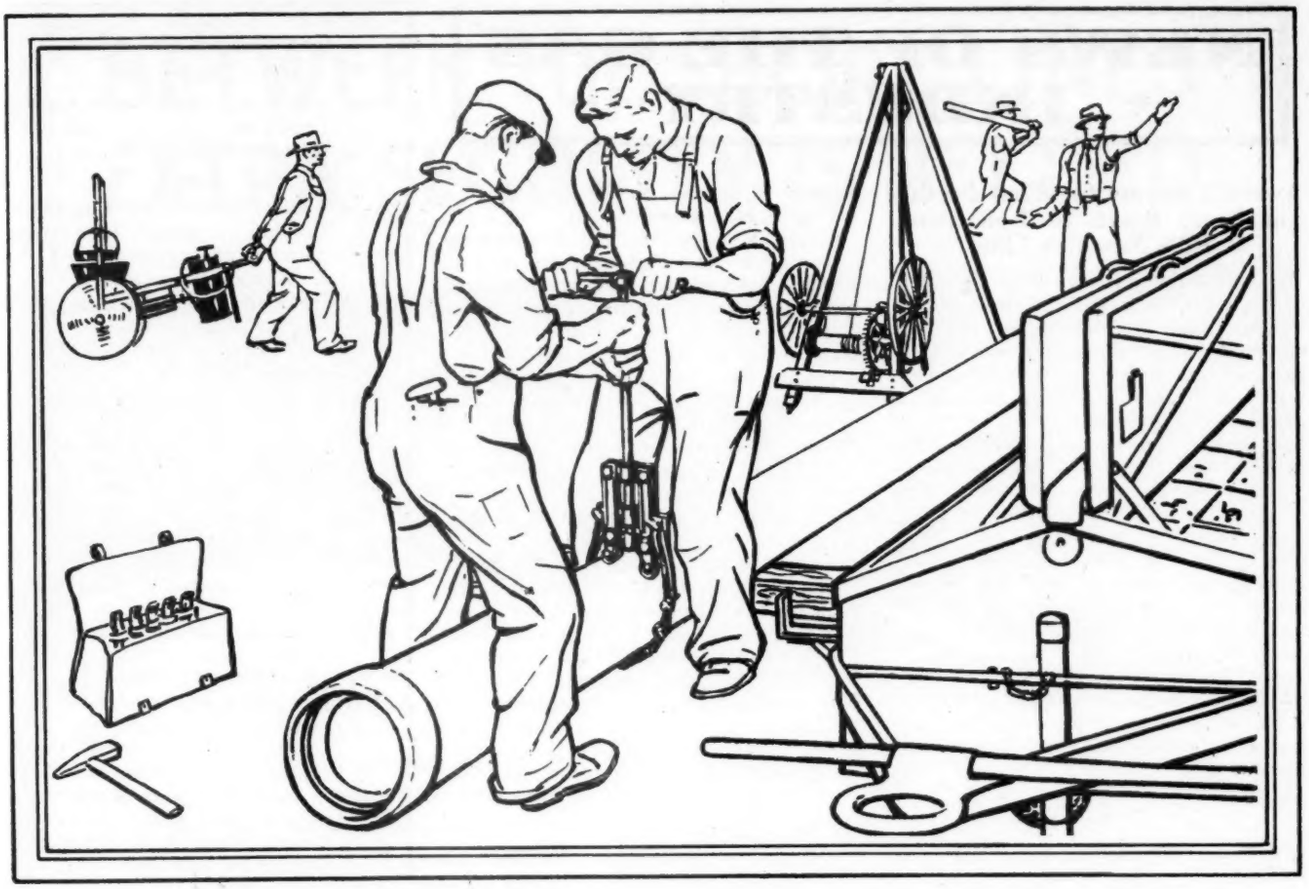
Descriptive circular will be mailed on request.

"Roberts Junior" conversion burner

New Soldering and Brazing Iron

The Reliance Specialties Mfg. Co., 122 E. 42nd St., New York, announce the new "Torchiron." It is a soldering iron that works with manufactured or natural gas with low air pressure, and can also be used as a torch for brazing. Illustration shows how rubber hose is attached to gas outlet, and any length can be used to fit the work to be done. Sizes run from ½ lb. to 10 lbs. and the iron is specially adapted for use in the meter repair shop. Descriptive circular will be mailed on request.



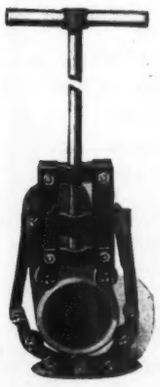


POLLARD
PIPE LINE EQUIPMENT

FOR THE BEST JOB YOU MUST HAVE THE BEST TOOLS

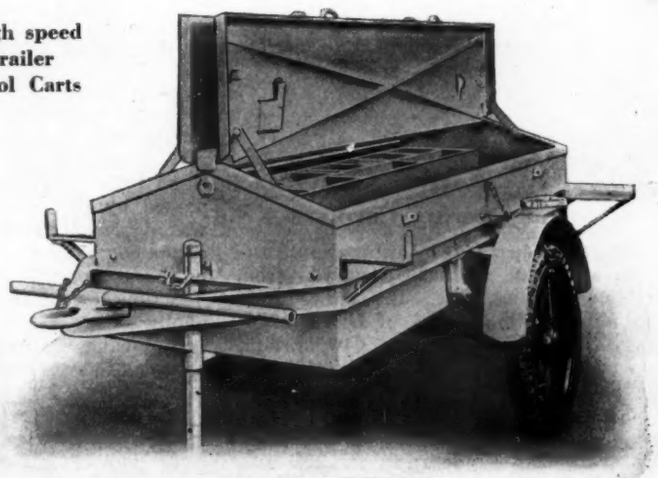
The most modern and economical equipment must be judiciously selected in order to speed up the laying of pipe.

Why not choose your pipe line equipment with the assurance of dependable and economical service, by using Pollard Pipe Line Equipment.



PIPE CUTTERS
Cuts 4" to 12" Pipe

High speed trailer Tool Carts



Catalog 14H on Request

JOSEPH G. POLLARD CO., INC.

Western Warehouse:
1749 West Lake Street
Chicago, Ill.

Main Office & Factory:
142 Ashland Place
Brooklyn, N. Y.

Canadian Distributors: Francis Hankin & Co., Ltd., 2028 Union Ave., Montreal

NEWS OF THE GAS INDUSTRY

Award Contract for First Section of Long Beach to Kettleman Hills New Gas Line

Mr. Alexander B. Macbeth, President of the Southern Fuel Company, announces that a contract for the first million dollars section of the new twenty-six inch gas line from Long Beach to Kettleman Hills has been awarded to the Los Angeles firm of Lindgrin & Swinerton, Incorporated, Builders, located at 529 Pacific Mutual Building.

"This section covers about twenty-seven miles from Long Beach to Glendale," stated Mr. Macbeth. "When completed the line will bring Kettleman Hills gas to Southern California for the use of the local gas companies and the Southern California Edison Plant at Long Beach."

Mr. Joshua H. Marks, Vice-President of Lindgrin & Swinerton, stated that the work is to be started immediately, and that this section should be complete by the middle of summer.

Minnesota Northern Power Co. to Operate Minot Company

The Minnesota Northern Power Company very recently purchased a half interest in the Minot Gas Company of Minot, North Dakota, and will take over the operations of the Minot Gas Company.

They will proceed with arrangements to build a natural gas line into Minot from Williston in 1932.

Contracts for Natural Gas

The F. C. Henderson Company of Tulsa, Oklahoma signed a contract to purchase a minimum of 10 million cubic feet of natural gas, daily, from the Texorado Oil & Gas Company with gas wells in Sanford, Hutchinson county, Texas, the gas to be delivered to Henderson's plant at Sanford, gasoline to be extracted and Henderson to market the dry gas.

Appalachian Gas Corporation Acquires Union Management and Engineering Corp.

Appalachian Gas Corporation announces that it has acquired from Union Utilities, Inc., the entire outstanding common stock of Union Management and Engineering Corporation, operating managers of subsidiaries and affiliate companies in Appalachian Gas Corporation group. This move consolidates the operating structure of Appalachian Gas Corporation through unification of control, and will result in a saving in management costs.

Union Management and Engineering Corporation was organized in 1928 to manage both natural and manufactured gas properties. Under its supervision the 210-mile pipeline of Memphis Natural Gas Company was constructed, which company has since become one of the most successful in the industry. The pipeline, which has its source in the Monroe field of Louisiana, was built in record time, construction operations being started on September 7, 1928, gas was being turned on in Memphis on January 1, 1929, 125 days later.

Natural gas companies under supervision of Union Management and Engineering Corporation are Ohio Valley Gas Company, Ohio Southern Gas Company, Ohio Kentucky Gas Company, Wayne United Gas Company, Memphis Natural Gas Company, Allegheny Gas Corporation, Texas Gas Utilities Company, Commonwealth Gas Corporation and West Virginia Gas Corporation, constituting Appalachian Gas Corporation group.

Plan to Lay 200 Miles of Gas Mains in 1931

Public Service Electric and Gas Company will lay approximately 200 miles of gas mains this year in the New Jersey territory served by the company. Practically all of these mains will be constructed to provide service for new customers in communities already supplied with gas.

When the work is completed, the company will have in use more than 6,200 miles of mains, sufficient to reach from Newark to Honolulu, with 600 miles to spare.

As an indication of the growth of the gas business since Public Service was organized, there were but 1,495 miles of mains in service December 31, 1903.

Reorganization of Company Approved

Reorganization of the Public Service Company of Indiana, formerly the Interstate Public Service Company, under "The Indiana General Corporation Act" passed by the state legislature in 1929, was approved recently by stockholders of the company at a special meeting held in the company's general offices in the Traction Terminal Building in Indianapolis.

Following the meeting, articles of reorganization were filed with the secretary of state.

The Public Service Company of Indiana supplies electric and gas service to a number of communities in central and southern Indiana, and operates an electric interurban railway between Indianapolis and Louisville, Ky.

Convention Calendar

May

20-22 American Gas Association Production and Chemical Conference, Philadelphia, Pa.

June

2- 4 Institution of Gas Engineers, London, England, first international gas conference. J. R. L. Alexander, secretary.

4- 5 Canadian Gas Association convention, 24th annual meeting, Windsor Hotel, Montreal Quebec, Canada.

9-11 Southern Gas Association, Chattanooga, Tenn. G. H. Schlatter, Birmingham, Ala., secretary.

14-16 Public Utilities Advertising Association annual convention, New York City.

15-20 Domestic Appliance Course, A. G. A. Laboratory, Cleveland, Ohio.

22-27 American Home Economics Association, Book-Cadillac Hotel, Detroit, Mich.

26-27 New England Gas Association, summer sales conference, Hotel Griswold, Eastern Point, New London, Conn.

29-July 1 Michigan Gas Association, annual convention, Mackinac, Island, Mich. A. G. Schroeder, secretary-treasurer.

July

6-24 Summer Course for Home Service workers, Columbia University, New York.

September

(First week) Pacific Coast Gas Association convention, San Francisco, Calif.

October

12-16 American Gas Association, Atlantic City, N. J. Alexander Forward, 420 Lexington Ave., N. Y. C., managing director.

November

16-21 Third Annual Conference on Bituminous Coal, Pittsburgh, Pa.

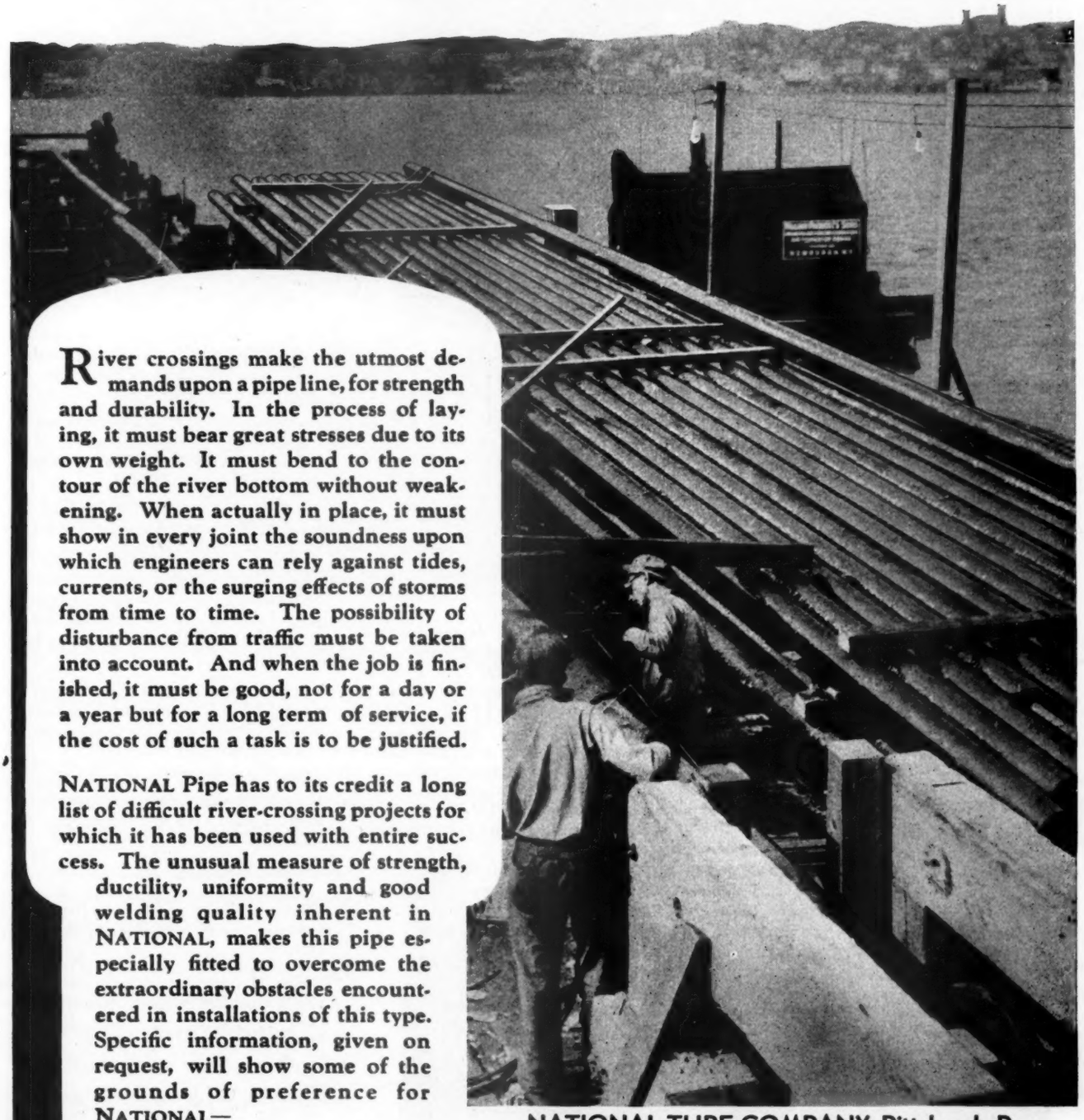
Industrial Gas Short Course

A short course in industrial gas engineering will be held at the University of Illinois beginning June 15 and lasting throughout the week. The course is under the direction of the University of Illinois; Professor D. B. Keyes presiding; and under the auspices of the Illinois Gas Association.

Address A. D. Frydendal of The Peoples Gas Light and Coke Company, Chicago, for further information.

(*News continued on page 88*)

BETWEEN THE SHORE LINES EXTRA SECURITY IS NEEDED



River crossings make the utmost demands upon a pipe line, for strength and durability. In the process of laying, it must bear great stresses due to its own weight. It must bend to the contour of the river bottom without weakening. When actually in place, it must show in every joint the soundness upon which engineers can rely against tides, currents, or the surging effects of storms from time to time. The possibility of disturbance from traffic must be taken into account. And when the job is finished, it must be good, not for a day or a year but for a long term of service, if the cost of such a task is to be justified.

NATIONAL Pipe has to its credit a long list of difficult river-crossing projects for which it has been used with entire success. The unusual measure of strength, ductility, uniformity and good welding quality inherent in NATIONAL, makes this pipe especially fitted to overcome the extraordinary obstacles encountered in installations of this type. Specific information, given on request, will show some of the grounds of preference for NATIONAL—

America's Standard Wrought Pipe

NATIONAL TUBE COMPANY · Pittsburgh, Pa.
Subsidiary of United States Steel Corporation

NATIONAL PIPE

Pacific Coast Gas Association To Stage Mammoth Natural Gas Exposition

The ideal characteristics of gas fuel, with emphasis on natural gas, will be the theme of the Thirty Eighth Annual Convention of the Pacific Coast Gas Association to be held in San Francisco, August 31 to September 5. This theme will pervade not only the Convention program, but will be visualized for the benefit of the people of Northern California in a Natural Gas Exposition which will occupy the entire main Hall of San Francisco's Civic Auditorium.

The Pacific Gas and Electric Company brought natural gas to Northern California from the famed Kettleman Hills field in June, 1930. This gas has a heat content of 1170 BTU and as it replaced a 550 BTU oil gas the company faced a tremendous decrease in sales and revenue. Mr. R. E. Fisher, the dynamic Vice-President in charge of Sales and Public Relations for the company, was not caught napping, for he immediately instituted what is perhaps the most intensive sales campaign in the history of the gas industry. This campaign is continuing during 1931 and Mr. Fisher, now President of the Pacific Coast Gas Association, has conceived the plans for an exposition in connection with the annual convention of that body which will not only serve as a source of information and inspiration to the Pacific Coast gas men who will be assembled, but also do much to educate the gas consumers of Northern California in the modern manner of using gas.

The Civic Auditorium in which the Convention and Exposition will be held was the scene of the 1924 Democratic National Convention. It is the largest building of its type in the West, with a main auditorium measuring 187 by 200 feet, flanked on each side by smaller halls. The Exposition will occupy the main auditorium and the adjacent halls will be devoted to a daily cooking school and the Convention sessions respectively. Billboards, newspaper advertising, and contests will be used in the publicity campaign. The major expense of the public Exhibition will be borne by the Pacific Gas and Electric Company, and invitations have been sent out to manufacturers of gas appliances and equipment soliciting their participation at moderate cost. The preliminary announcement points out that the Exposition in no way supplants or conflicts with the annual exhibits of the American Gas Association as it will reach an entirely different audience. There is no intention to make the Pacific Coast Exposition an annual affair.

R. E. Fisher

Mr. John F. Coghlan, Second Vice-President of the Pacific Gas and Electric Company, is General Convention Chairman. Mr. H. M. Crawford, General Sales Manager of the Pacific Gas and Electric Company and Chairman of the Association's Commercial Section, is Chairman of the Exposition Committee, with Mr. G. P. Egleston, General Manager of H. R. Basford Company, California Ruud distributors, as Director of Exhibits, and Mr. A. C. Joy, Manager of the Publicity and Advertising Department of the Pacific Gas and Electric Company, as Director of Advertising and Publicity.

Civic Auditorium, San Francisco

Program of Canadian Gas Association Meeting Montreal, June 4th and 5th

Geo. W. Allen, Secretary of the Canadian Gas Association announces that the following papers will be presented at the 24th annual meeting at Montreal, Canada, June 4th and 5th.

"High Pressure Distribution Systems for Suburban Towns," by A. C. Frey, Manager, Worcester Gas Light Co., Worcester, Mass.

"Intensive Selling of Gas House Heating," by S. F. Morgan, Gas Heating Engineer, New Bedford Gas & Electric Co., New Bedford, Mass.

"Gas Prospects in the Prairie Provinces of Canada," by Dr. George S. Hume, Geologist, Department of Geological Survey, Ottawa, Ontario.

"The Klonne Dry Gas Holder," by Max Klonne, Engineer, August Klonne Company, Dartmund, Germany.

"Some Possibilities in the Design of Small Gas Plants for Flexibility of Output," by E. W. King, Engineer, Hamilton By-Product Coke Ovens Ltd., Hamilton, Ont.

"Aeroplane and Cyclone Insurance for Gas Holders," by Harry Anderson, Insurance Division, Peoples Gas Light & Coke Company, Chicago, Ill.

"Modern Trends in Gas Engineering," by E. A. Munyan, Manager, Gas Department, Union Gas & Electric Co., Cincinnati.

"Gas Merchandising with Relation to Distribution of Load," by O. L. Maddux, Industrial Gas Engineer, United Gas & Fuel Co. of Hamilton, Ltd., Hamilton, Ont.

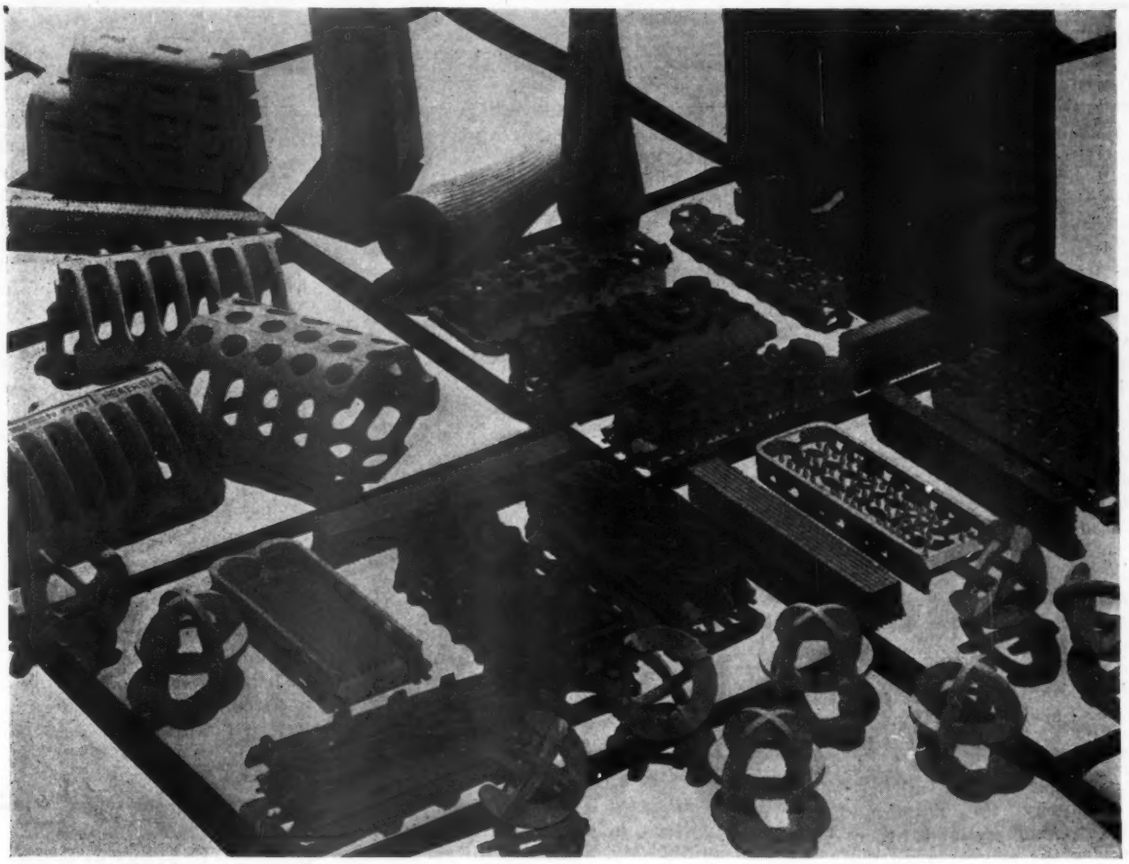
"Design, Laying and Maintaining Gas Pipes Crossing Under Railroads," by Olin F. Flumerfelt, Chief Engineer, Iroquois Gas Corporation, Buffalo, N. Y.

"Reclaiming Old Gas Pipes by Sandblasting," by E. A. Cummings, Vice-President, Moncton Tramways, Electricity & Gas Company, Ltd., Moncton, N. B.

"Progress in the Development of Major Long Distance Transmission lines," by W. G. von Gemmingen, Consulting Engineer, New York City, N. Y.

"Natural Gas in Ontario," by Col. R. B. Harkness, Commissioner Natural Gas, Province of Ontario, Toronto.

many nationally marketed gas appliances are Genceraco equipped



Neat because neatness always counts— Strong, where the burden of performance falls

Hundreds perhaps thousands of times each day your products must pass inspection in the eyes of cautious buyers, eyes which glance, then examine and, perhaps, approve. Yet through it all, only attractiveness can convey that essential promise of performance within the instant of a single glance. After that, strength must be apparent.

In Genceraco refractory construction you will find the answer to many knotty problems. You will find neatness, because appearance always counts, strength because upon structural strength the burden of performance falls. Each unit is built to meet the acknowledged high standards of this Company, standards established upon a thorough knowledge of materials, unrelenting plant control and the ability which can combine both to produce refractories of highest value.

Space Heater Radiants
Back Walls
Tunnel Radiants
Leaning Baffles
Radiant Sticks
Burner Tips
Skeleton Cups

May we send you complete information? Your request will bring immediate response.

GENERAL CERAMICS COMPANY
71 West 35th Street
New York City New York

REFRACTORIES, the heart of gas appliance performance

Personals

G. A. Gilkerson, formerly Educational Director of the Public Service Company of Northern Illinois, Chicago, has been appointed Director of Sales Training.

Mr. Gilkerson has been selected to represent the sales organization in conducting a complete sales training program because of his wide and long experience in this field. He will conduct and develop a sales training program through the district supervisory force who in turn will be responsible for the direct training of individuals.

Mr. Gilkerson has wide experience in personnel work and vocational training. From 1912 to 1915 he was the Company's Supervisor of Safety. After an interim of ten years in other work, the last six years of which were spent as Vocational Guide and Training Officer of the U. S. Veteran's Bureau, Mr. Gilkerson came back to the Company as Director of Education in 1925.

William M. Large, formerly district manager of the Interstate Public-Service Company at Connersville, Ind., has taken charge of properties in Huntington, Ind., belonging to the Northern Indian Public Service Company. He succeeds Paul McLeod, who went to Newcastle, Ind., recently where he became division manager for the Indiana public service Company, the Traction Light and Power Company and other companies under the same management.

Mr. Large has had more than twelve years experience in the utility field. He has been connected with the Denver Gas and Electric Company, the Federal Electric Company of Denver, the Indiana Service Corporation and the Interstate Public Service Company.

H. L. Farrar, General Gas Superintendent of the Western United Company, Aurora, Ill., resigned recently to accept a position with the Standard Management and Operating Corporation. In his new position, Mr. Farrar will have charge of the gas operations of the entire group of gas and electric properties managed and operated by the Standard Company in the States of California, Oregon and Washington. His new headquarters will be in San Francisco.

A. G. Ford has been appointed General Superintendent, Gas Department of the Western United Company, Aurora, Ill., succeeding H. L. Farrar, resigned.

Roy S. Nelson recently took over the management of the Baton Rouge, La., Electric Company and Louisiana Steam Products, Inc. of which latter company he was elected president.

Mr. Nelson comes to Baton Rouge from the Virginia Electric & Power Company, where he was general manager of the electric department.

F. Tourtellotte has been placed in charge of merchandise sales of the Webster Division of the Webster & Southbridge Gas & Electric Company, Webster, Mass. He succeeds Edward Bergeron who has taken over the duties of lighting specialty engineer.

Jacob B. Jones, Superintendent and General Manager of the Bridgeton, N. J. Gas Light Company was recently tendered a testimonial dinner by 40 of his business and fraternal associates on advent of his fiftieth birthday. Mr. Jones is well known in the gas industry, having served as President of the New Jersey Gas Association and on important committees of the American Gas Association. Mr. Jones is also very active in civic affairs, and is at present serving his county as member of the Sinking Fund Commission. For two years he was secretary to the president of the New Jersey Senate.

Jacob B. Jones

E. A. Olsen, vice president of Pacific Public Service Company, and its subsidiaries, recently announced his resignation from this company to take over the executive management of the Oklahoma Natural Gas Company with headquarters in Tulsa.

Mr. Olsen will direct the operations of the company which has distribution systems in practically every Oklahoma city. More than fifty cities, including Tulsa, Oklahoma City, Muskogee, with an excess of 127,000 domestic consumers are served by the Oklahoma Natural Gas Company and under Mr. Olsen's direction also will come several hundred miles of natural gas pipe lines.

Mr. Olsen has been an outstanding figure in western public utility operations since the independent Coast Counties Gas and Electric Company passed into the hands of Standard Oil Company of California two years ago.

Mr. Olsen was associated in an engineering capacity with the North American owned public utility companies in Wisconsin. He later joined with Day and Zimmerman, engineers and operators of public utilities in Virginia, Georgia and eastern states. Subsequently Mr. Olsen had the management of public utilities in Georgia and Florida including the Georgia Power and Light and the Florida Power Corporation for the Insull interests. He came to California from Florida.

E. M. Lindsey has been appointed General Manager of Natural Gas Corporation of California. Mr. Lindsey has been with the natural gas companies for the past several months, first as engineer for Standard Management and Operating Corporation, which organization is actively engaged in utility construction and operation throughout the entire Pacific Coast area, and then as general superintendent of the trio of Natural Gas organizations.

Previous to coming to the coast, he was superintendent of transmission and distribution construction and operation for the Florida Power Corporation, and was also with the General Electric Company for a number of years.

With his new appointment as General Manager of Natural Gas Corporation of California, Mr. Lindsey will be in active charge of all properties of the company, which now include plants in operation at Vacaville, Rio Vista, Isleton, Suisun, Fairfield, Brawley, Calexico, El Centro, Dunsmuir and Yreka, with a plant and distribution system soon to be completed at Arcata. He will make his headquarters at San Francisco.

Obituary

WALTER ROBARTS ADDICKS

Walter Robarts Addicks, senior vice-president of the Consolidated Gas Company, died of pneumonia recently at his home, Greenwich, Conn. It was his seventieth birthday. His wife, Mrs. Margaret Jardine Addicks, survives.

Mr. Addicks was one of the recognized authorities in gas engineering in this country and had before beginning his twenty-eight years of office as vice-president of the Consolidated, been associated in the role of engineer with many other concerns.

Born in Philadelphia, he attended the Episcopal Academy there and in 1882 he was graduated from the United States Naval Academy. Although he resigned from the Navy in the following year to become a draftsman with the Pennsylvania Railroad in Altoona, Pa., he re-entered the service as a second lieutenant, senior grade, during the Spanish-American War, when at times he commanded the U. S. S. Eileen and the U. S. S. Huntress, vessels detailed to lay mines in New York Harbor. Mr. Addicks was a member of the Naval and Military Order of the Spanish-American War and of the United States Naval Academy Graduates' Association.

(*Obituary Continued on Page 92*)

THE SWEEP *is to* STAT-AMATIC Temperature Regulators

Here's the Reason

Stat-Amatic Dual Control Thermostat "Day" and "Night Setting"

Stat-Amatic Electric Motor-Wound Clock automatically shifts from the "Day" to the "Night" setting.

STAT-AMATIC is Completely Automatic. When once installed and set, it requires no further attention—not even a clock to wind.

STAT-AMATIC **being completely automatic, removes the bothersome and costly service calls so common in many types of regulators.**

STAT-AMATIC, enables you to say "This Gas Furnace is now automatically controlled," and you can emphasize every word of it.

STAT-AMATIC Dual Control Thermostat and Electric Motor-Wound Clock are the chief reasons for Stat-Amatic unfailing reliability.

STAT-AMATIC is more than human, because "it never forgets."

REMEMBER! Stat-Amatic is the One Heat Control and Temperature Regulation device that brings about the last word of efficiency for Gas Fired Furnaces.

☞ SEND THIS TODAY—

Stat-Amatic Instrument & Appliance Company
Hartford, Conn. GJ.

We want more information about Stat-Amatic for Gas Furnaces.

.....
company

.....
individual title

.....
address

Stat-Amatic is playing an important part in stimulating interest in, and creating sales for Gas Furnaces for homes by providing Complete Automatic control. "There's a Stat-Amatic Man near you."

Obituary

(*Continued from page 90*)

WALTER ROBARTS ADDICKS

With the exception of the war interim he was engaged successfully from 1887 to 1903 as engineer with the Beacon Construction Company, of Boston; chief engineer of the Bay State, Boston, Roxbury, South Dorchester Gas Companies; consulting engineer of the Brooklyn, Metropolitan and Citizens Gas Companies, of Brooklyn; chief engineer of the Brookline Gas Light Company and consulting engineer of the Massachusetts Pipe Line Gas Company and the N. E. Gas and Coke Company.

In 1903 Mr. Addicks accepted the first vice-presidency of the Consolidated Gas Company and became a director of several of its subsidiary units. He had been senior vice-president since 1925. He was also president of the United Electic Light and Power Company from 1904 to 1912, president of the Municipal Lighting Company from 1906 to 1913 and vice-president of the Green Mountain Lake Farms, a recuperative resort for employees of the Consolidated and affiliated companies.

Mr. Addicks was an associate member of the Empire State Gas and Electric Association and the National Fire Protective Association, an honorary member of the Society of Gas Engineering of New York and the Guild of Gas Managers, of which he was at one time president, and a member of the American Gas and National Electric Light Associations.

RICHARD R. YOUNG

Richard R. Young, vice-president in charge of sales of the Public Service Electric and Gas Company, died April 30. Mr. Young underwent an operation, but his condition was not regarded as serious until a few hours before his death. He was sixty-four years old.

Mr. Young was born in a suburb of London and came to this country in 1886. He operated a ranch in Nebraska for several years, and in 1892 became associated with the Omaha Gas Company. Seven years later he moved to Passaic, N. J., and became agent for the Paterson and Passaic Gas and Electric Company.

When the Public Service Gas Company was formed, in 1909, he was employed as a division agent. He was made new business agent when the Public Service gas and electric companies merged. In 1926 he became vice-president in charge of sales.

HARLOW C. CLARK

Harlow C. Clark, director of publicity, Public Service Electric & Gas Co., Newark, N. J., died April 10 at his home in East Orange, N. J. He had been in ill health for a long while.

Mr. Clark was well-known throughout the gas industry, and was active in the work of the American Gas Association. Mr. Clark was a former newspaper man and an authority on public utilities.

Born in Syracuse, N. Y., Mr. Clark worked in the freight and transportation departments of the New York Central lines and the Lehigh Valley Railroad, and in 1892 returned to Syracuse, where he entered the newspaper field. In 1920 Mr. Clark took the position which he held last.

He is survived by his widow, Mrs. Mary C. Clark, and two sisters.

TRADE NEWS

United Engineers and Constructors, Inc.—Activities

Jersey Central Power & Light Company, Asbury Park, N. J. has awarded contract to furnish deliver and install at Long Branch, N. J. equipment for large oil tank covering pipe coils, piping within the tank, structural steel supports for pump, with foundations for same. Also contract to furnish necessary material for equipping the second 11′ set for the use of The U. G. I. Heavy Oil Process.

The Gulf Refining Company of Philadelphia, Pa. has awarded contract to furnish f.o.b. cars Girard Point, Philadelphia, two (2) 8′0″ diameter by 8′6″ high circular steel purifier boxes, with trays, gas branches.

The Public Service Electric & Gas Company of Newark, N. J. has awarded contract to furnish, deliver and install at their Paterson, N. J. works, one (1) 5′2″ x 18′0″ x 30′0″-eight-pass U. G. I. High Duty Condenser, with gas connections.

New York Power & Light Corporation, Albany, N. Y. has awarded contract to construct the following gas mains and distribution system, consisting of:

Approximately 91,500 feet of 6″ high pressure main from Saratoga Springs to Glens Falls, N. Y., approximately 91,000 feet of 6″ high pressure main from Amsterdam to Gloversville, N. Y. and a distribution system at Canajoharie, N. Y.

Michigan Gas & Electric Company, Ashland, Wisconsin, has awarded contract to furnish, deliver and install at Marquette, Michigan, one (1) bench of 6 type "S" U. G. I. Vertical Chamber Ovens, together with Fuel Tower, Condenser, Exhauster, Immersion Washer, 2 rectangular Purifier Boxes, meter. Yard connections and gas By-passes, Piping and Dismantling work.

The Wisconsin Public Service Corporation, of Milwaukee, Wisconsin, has awarded contract to furnish deliver and install at Oshkosh, Wisconsin, one (1) 9′0″ U.G.I. Carburetted water gas apparatus, with back run, the set arranged for use of bituminous coal as generator fuel, and necessary changes to existing waste heat boiler for converting the boiler so as to use both boilers for blast gases only, tertiary blast connections.

Pennsylvania Power & Light Company, Allentown, Pa. has awarded contract to furnish, deliver and install at Shenandoah, Penna., one (1) 4′0″ x 10′0″ flat top generator, with fire brick linings, castings, and grates.

Recent Contracts Received by the Gas Engineering Co.

The Safety Mining Company of Chicago have placed a contract for the furnishing and installation of a CO_2 recovery Plant to be erected at the Benton Coal Mines, Benton, Ill. This plant will be of most modern design and construction and the process used in the recovery of CO_2 is known as the Girdler Gas absorbtion process.

The Safety Mining Company of Chicago have also placed a contract for a 50# CO_2 plant to be installed at the #2 mine of the Raleigh, Wyo. Mining Company, Glen Rogers, W. Va. This plant will be of a similar design and construction as that which is being furnished at Benton, Ill., and the same type of process will be used.

The Florida Gas Company has placed a contract to furnish and install a Butane Plant at Eustis, Florida. This plant will be designed to furnish Butane gas for Eustis, Fla., and two or three nearby towns and will be most modern in design and construction.

New Patrol Valve Co. Catalog

The Patrol Valve Co., W. 114th St., Cleveland, O., recently issued a catalog describing their pilot and temperature controls. It illustrates and describes the "Patrol-Flash Lighter" for all types of gas ranges. The lighter is built for use with the "Patrol" safety valve, which protects against the escape of gas in event the pilot flame is extinguished. The catalog also contains illustrated descriptions of the "Patrol" cut-off valve, "Patrol" room control automatic heat regulator and the "Patrol" relief valves.

(*Trade News Continued on page 94*)

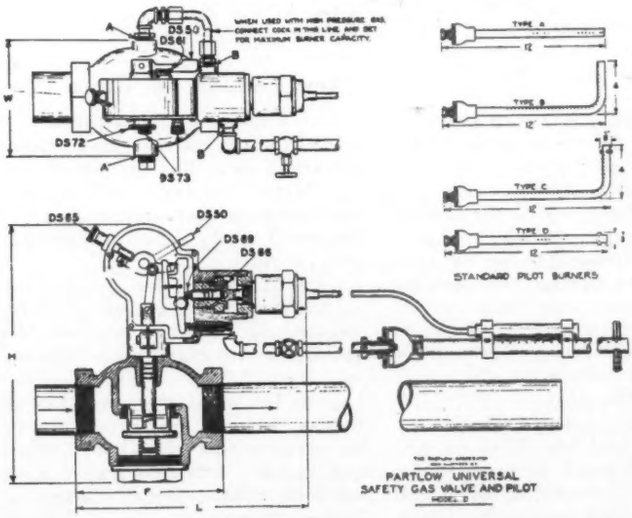
SUPERIOR

Gas Meters
Provers
Service Cleaners
Diaphragms
Repairs

SUPERIOR METER CO.
167-41st Street
Brooklyn, N. Y.

A New "Fool-proof" Safety Pilot

They said it couldn't be done . . . but by means of a temperature control within a Safety Pilot we're making all gas-burning appliances absolutely safe.



The principle of operation is based on the expansion of mercury in a thermostat bulb which is heated by the pilot burner.

The gas valve shuts off the gas supply to both the pilot and the main burner in event the pilot light becomes extinguished or the gas supply is interrupted.

The gas valve holds in an open position, temporarily, that the burner may be lit without waiting for thermostate to heat up. Thermal content of gas, gas pressure or draughts effect the valve in no way.

Send for illustrated folder "A"

THE PARTLOW CORPORATION--New Hartford, N.Y.

McWane Cast Iron Pipe Co. to Move Eastern Offices to New York

The McWane Cast Iron Pipe Company, of Birmingham, announced the removal on April 15th of its eastern sales offices from Philadelphia to Suite 1408 Lord Court Building, at 40 Exchange Place, New York City.

Porter W. Allen, for the past several years in charge of the Philadelphia offices, continues as Eastern sales manager for the McWane interests in the new location.

The move, it is stated, is prompted by the growing concentration of gas and water pipe buying in New York among the strong group of utilities headquartering there; while its midway position between Philadelphia and Boston will enable the New York office to maintain close relations as before with the important sales territories in those cities as well.

Stacey Engineering Co. Takes Over International Derrick & Equipment Co.

The Stacey Engineering Company, Cincinnati, Ohio, which recently put into one company The Connersville Blower Company and the P. H. and F. M. Roots, Connersville, Ind., the Wilbraham-Green Blower Company, Pottstown, Pa., and the Stacey Bros. Gas Construction Company of Cincinnati, O., have merged into the company the International Derrick & Equipment Company of Columbus, Ohio. The name of the Stacey Engineering Co., has been changed to the International Stacey Corporation and it is announced that headquarters of the new company will be located at Columbus, Ohio.

Mr. J. S. Tatman, president and general manager of the Blower Division will remain in charge of those companies at Connersville, Ind. Harry M. Runkle, of Columbus, Ohio, President of the International Derrick & Equipment Company will be President and General Manager of the new company and in direct charge of all operations. Wayne B. Stacey, vice-president of the Stacey Engineering Co., will remain in charge of the Holder Division at Cincinnati, Ohio.

New Reznor Literature

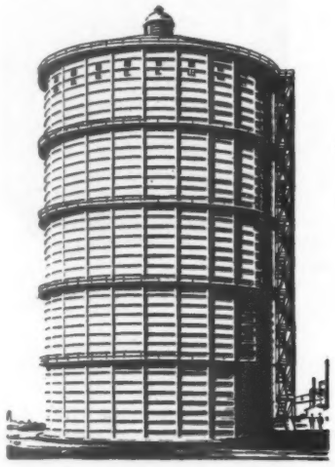
The Reznor Manufacturing Company, Mercer, Pa., recently issued two folders describing the Reznor gas fired warm air forced circulation heater Type V and Reznor gas fired warm air heating and ventilating unit Type 1-UR. The Type V heater has been developed to meet the demands in heating factories, shops, warehouses, public garages, auditoriums, etc. The Type 1-UR is suitable for heating various kinds of spaces and supplying supplementary heat where heating system is inadequate.

The folders contain details of design and construction, engineering data and many illustrations.

Copies of these folders can be obtained on request to the Reznor Mfg. Company.

Syracuse Contracts for Stacey-Klonne Waterless Gas Holder

The Syracuse Lighting Company at Syracuse, New York has awarded to the Stacey Bros. Gas Construction Company of Cincinnati, Ohio, the Holder Division of the Stacey Engineering Company, a contract for the fabrication and erection at Syracuse, New York, of a 6,000,000 cubic foot Stacey-Klonne waterless or piston gas holder.



Stacey-Klonne Holder

There are approximately thirty Klonne holders in service or under construction in Germany, France, England, Belgium, Holland, Czecho Slovakia, Italy, Switzerland and Africa, the oldest of which have been in service approximately five years.

The accompanying illustration shows the general exterior appearance of the Stacey-Klonne waterless gas holder, which is cylindrical in form for its full height with a cone-roof surmounted by a turret.

The interior of this holder is provided with a moveable piston beneath which the gas is stored, the height of the piston varying as the volume of the gas increases or decreases within the holder.

The circular form of the shell and piston permits the unique, flexible, expanding sealing ring, carrying the packing and mounted on the outer perimeter of the piston, to accommodate itself to the shell with a minimum of resistance to slight variations or distortions which may be caused by wind or heat.

The numerous carriage wheels installed at the top and bottom of the triangular structural frame secured to the top of the piston for guiding same are made of wood or special composition having similar characteristics.

The piston is sealed against the shell of the holder by several layers of an especially prepared lubricated packing, mounted on the aforesaid flexible expanding sealing ring, making the holder gas tight.

Semet Solvay Acquire Patents on Koller Gas Producer Together with Other Industrial Gas Equipment

The Semet-Solvay Engineering Corporation of New York has acquired patents and manufacturing rights relating to the Koller gas producer and the Koller mechanical grate, together with the industrial gas equipment formerly manufactured and sold by the Gas Research Company and the Smith Gas Engineering Company of Dayton, Ohio. Both of these lines will be further developed and marketed with the present Semet-Solvay Engineering gas and coke plant and welded equipment.

The Koller grate offers a number of exclusive features which give high efficiency to gas producer operation. The grate design is being applied to mechanical operation of carbureted water gas generators.

Folder Describes New Partlow Safety Pilot

The Partlow Corporation, New Hartford, N. Y., announce in a descriptive folder recently issued the new Partlow Universal Safety Gas Valve and Pilot. It is claimed this pilot automatically shuts off absolutely all gas in case of any interruption in the gas main; or if the pilot should be extinguished. It is unaffected by draft, thermal content or pressure of the gas. Fits every kind of gas-burning appliance. The principle of operation is based on the expansion of mercury in a thermostat bulb which is heated by the pilot burner. This expansion is arranged to hold the safety valve in an open position. If the pilot light goes out the mercury contracts and within a few seconds the valve closes.

Copy of folder can be obtained on request to the Partlow Corporation.

New Catalog on Meter Provers

The Publication Department of American Meter Company has released an attractive new 36 page revised bulletin on Meter Provers and Cubic Foot Standards for gas meters manufactured by the D. McDonald and Company factory in Albany, N. Y.

The bulletin includes complete data on the new 5 and 10-foot provers. The capacity of these models has been respectively increased from 950 to 2,300 and from 1,800 to 5,000 cubic feet per hour at 1½" inlet pressure. The booklet further includes instruction for operating provers, cubic foot bottles (both Immersion and Portable Type) apparatus for Determining Meter Capacities, and Hydro Pneumatic Meter Testers. A Check Rate and Open Rate Table, Meter Proving Percentage Tables and data on the adjustment of meters to accurate proof, are presented.